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SOME ADVANTAGES OF COMMISSION REGULATION OF PUBLIC UTILITIES

With the increasing development of state regulation of public utilities, it is well to call attention to the fact that, notwithstanding some belief to the contrary, the public-service corporations under state regulation enjoy rather pronounced advantages which are none the less real because not immediately apparent. When the majority of the public-utility laws were drawn up, the fact was recognized that if public-service corporations were to be controlled and regulated, they must at the same time be protected. In general, this protection is afforded in two ways—protection from the ruinous effects of aggressive competition where circumstances do not warrant a second utility, and an assurance of a reasonable rate of return upon an equitable valuation to reward an adequate service rendered. The first is made possible through the agency of the so-called "convenience and necessity law" which is operative in most states under commission control. The law recognizes that a public-service corporation is, in its very nature, monopolistic in character, and protects it from competition except where the public welfare demands the existence of a second utility. The utility commission in administering the law determines whether such a second utility is necessary or not. This provision, as Chairman Roemer of the Wisconsin commission has put it, is not intended as auxiliary to the power of the commission to enforce rates and service, as is sometimes erroneously assumed, but is a remedy of last resort and may be applied only in exceptional cases. A public-utility business, if properly conducted, is virtually safeguarded under this law. In Wisconsin not a single certificate of convenience and necessity has ever been granted to an electric central station, although several requests for such have been made. Under this law it is impossible, practically, for a municipality to operate its own plant in competition with an existing private plant. Under certain conditions the municipality has the right under the law to purchase the private plant at a valuation fixed by the commission. Very few municipalities have availed themselves of this opportunity, for experience has shown that where the public can obtain all the advantages of public ownership without any of the disadvantages it is good policy to keep out of the electric central-station business.

One of the great benefits accruing to a public-service corporation operating under commission regulation results from the required standard method of accounting, which enables the utility to know the exact condition of its business, its growth from year to year, and to detect the previously unsuspected unprofitable business. Furthermore, an accurate knowledge of a utility's business and the condition of its finances makes it possible for a commission

such as the Wisconsin commission to formulate after a careful investigation a rate schedule which follows the cost of service as nearly as practicable and which guarantees to the utility concerned a fair and reasonable rate of interest and an ample depreciation fund. That a rate schedule which is formulated by an impartial commission and which recognizes all the elements of expense will result in the fullest development of a profitable business has been amply demonstrated. In this connection the case may be cited of the Madison Gas & Electric Company, whose rates were reduced and a new rate schedule devised in a decision of the Wisconsin commission under date of March 8, 1910. During a three-year period including a year's operation under the new schedule, with a public confidence that the rates were reasonable and with no effort to secure new business, the company's residence-lighting consumers increased 34 per cent, and the number of kilowatt-hours sold for this purpose increased 70 per cent, chiefly during the last year of the period. Notwithstanding the decrease in rates, the revenues increased 35 per cent for the class. During the same period stores actually decreased their installations but increased the amount of energy consumed by 25 per cent. This increase in business did not require an increase in station capacity, but was brought about by a longer use of the connected load and an increase in the number of appliances used—a condition of affairs encouraged by commission action. This increased business, together with a more economical management, increased the net earnings of the company from 3.06 cents to 3.25 cents per kw-hour sold. Similar results were noted in the city of Ripon, Wis. The commission reduced the rates of the Ripon Water & Light Company and ordered a revised rate schedule. One year's operation under the new rates has shown that in the case of residence consumers the connected load has decreased about 4 per cent, whereas the number of consumers has increased 10 per cent and the consumption of electricity 22 per cent as compared with the year previous. The total energy consumption increased materially, but at the same time the instantaneous maximum demand remained practically unaltered. This increase in business occurred in spite of the fact that one class of business was abandoned because shown to be an actual loss.

In every case in Wisconsin where a utility has kept its accounts in proper shape and has petitioned for an increase in rates the increase has been granted, provided the service rendered was satisfactory and an increase was necessary in order to assure a reasonable rate of return after allowing for an ample depreciation fund. This increase in net revenues has been accomplished either through an actual increase in rates, a modification of the minimum bill or a revision in the percentage of active connected load. It is rather interesting to note that of the numerous petitions requesting an increase in rates on the part of municipal electric plants not one has as yet been granted, for the reason that their accounts, as a rule, have always been kept in such miserable shape that absolutely no information could be obtained from them that would warrant a rate increase. The commission has invariably dismissed the petitions with a statement that until a proper record has been kept no change in the existing rates could be ordered. The effect has been that municipalities are beginning to be better informed concerning the condition of their electric-utility business. Electric railway companies have found commission authority to their advantage in cases where their charter or franchise contained maximum-fare provisions which were found to be insufficient to return a proper interest on the investment.

It is stated upon good authority that in every single case where the Wisconsin commission has ordered a revision in rates, whether an increase or decrease, the utility concerned has enjoyed a marked increase in business and in net revenues. The average utility, like an individual, is very apt to get into a rut, and unless it gets out, either of its own accord or because compelled to, it can show nothing but a very mediocre development. After all has been said concerning the advantages of commission control, the strongest indorsement and the most convincing testimony comes from the very men who a few years ago were most bitterly opposed to state intervention in the utility business, but who now, after a better understanding through actual contact with it, are among its most loyal and enthusiastic supporters.

TREATMENT OF LOW-GRADE ORES BY ELECTRICAL PROCESSES.

One of the subjects discussed at the recent annual session of the American Mining Congress in Chicago and of particular interest to electrical men related to the Malm process of reducing complex low-grade ores. This is a combination of the chlorine process and the electrolytic method, the use of electricity being particularly applicable to the recovery of zinc, the value of which is said to run as high as $18 a ton in some of the refactory low-grade ores for which this method is intended primarily. The principal cost of operating the process is due to the purchase or production of electrical energy for the electrolytic reduction of the zinc chloride. The advantage of the process lies in the fact that zinc has been considered an unwelcome and particularly refractory element of the complex ores, and has been wasted to a large extent heretofore. In the Malm process the zinc recovered may very well be the most valuable constituent of the ore. Dr. Malm and his spokesmen are understood to have made a very interesting proposition to the American Mining Congress. They suggested that the organization appoint a committee to investigate the various processes for reducing low-grade complex ores, and if the committee should find after disinterested investigation, considering all the available methods, that the Malm process is an economical and valuable one it be asked to report the fact to the congress at a future session, recommending the adoption or official authorization of this method. In that event it is understood that the inventor will be willing to contribute the Malm process, which is covered by patents, freely to the mining industry, making a donation of it if some official body can be found to receive it and appreciate and push it. Otherwise, the invention will be pushed by private capital, and possibly a situation may arise analogous to the so-called "smelter trust."

The official action of the congress did not go so far as this. In its resolutions the mining congress declared, however, that "the development of processes of ore treatment capable of handling with profit the vast low-grade deposit-

and mine dumps of our mining districts is of the greatest importance to the mining industry and to all related industries." Therefore it was declared to be the sense of the American Mining Congress that the Congress of the United States be asked to provide for the establishment, under the direction of the Bureau of Mines, of a metallurgical experimental ore-testing station to devise methods for the extraction of metals from low-grade ores. The mining congress also volunteered to draft a bill providing for the establishment of such a testing station. The subject is one of interest and importance to the electrical industry, for if the Malm process, or some analogous process, is widely adopted it means a greatly increased consumption of electrical energy in the metal mining industry.

FARMERS' ELECTRICAL SUPPLY.

The recent Illinois State Electric Association convention brought out an interesting symposium on rural transmission lines for the supply of farmers. There is a considerable amount of such service at the present time in certain sections of the country, notwithstanding the very small revenue per mile of pole line which such business offers. Where farmers are supplied from existing single-phase or three-phase transmission lines running between towns the problem is not so much one of pole-line cost as of the cost of the necessary step-down transformers and lightning protection. This problem, which is now receiving attention from manufacturers and transmission-line operators, is one which is fairly near a solution. Another problem relates to distribution from the nearest town or main transmission line to the farmer's premises. This is much more serious, for it involves an investment in pole lines which is prohibitive in many farming districts. From information brought out at the Illinois convention and elsewhere it is evident that pole lines for supplying farmers cost from $150 to $600 per mile. The lowest figure applies to 2200-volt lines of iron wire with small 25-ft. poles, about thirty to the mile; in other words, to a very light construction subject to rapid deterioration, which deterioration, however, is not in itself so grave as the probable danger and interruption to service caused by the frequent breaking down of such lines after a few years' use. On the other hand, it is impracticable to follow out expensive city line-construction standards in country work. At any rate, it is probably useless to count on carrying on extensive farm-service business over pole lines costing less than $200 per mile. Now, with such a pole-line investment added to the other investments necessary, the number of consumers per mile of line must be more than is commonly found available, or the amount of electricity taken by each consumer per year must be considerably more than the ordinary requirements of house lighting.

Probably few investors can be found who would be willing to go into enterprises of this kind, which show in prospect less than 20 per cent for interest, profit and depreciation on the entire investment. With an investment of, for example, $200 per kilowatt of maximum demand to reach a rural distributing center, and a further investment of $100 to reach a farmer with 1 kw of maximum demand, a revenue of $60 per year would be required from that one farmer customer alone. This is by no means an unusual example, as in the majority of cases the cost would be higher than this. At the same time there are many cases where conditions are more favorable. Whether the electric-service company assumes the investment of the necessary pole lines to reach each individual farmer, or whether part of this investment is taken by the farmer himself, as in a number of the cases reported in Illinois, it is evident that the ultimate success of rural electric distribution is dependent on a much larger use of electricity by each consumer than would be necessitated by lighting alone. It is a question of using sufficient electricity for power and heating requirements of the farm to bring the revenue per consumer up to a profitable point. The principal power-consuming operations of the farm consist of water-pumping, feed-cutting, grinding, plowing, harvesting and hoisting for storage. Horses and windmills have been the chief sources of power aside from manual labor on the farm, but gasoline engines are already finding extensive use. The use of such engines should be encouraging to the electrical man, rather than the reverse, because mechanical power as furnished by the gasoline engine is sure to cause an evolution or development away from the old methods and to create a demand for mechanical power, which will pave the way for electric-motor service where it is available. As brought out at the Illinois convention, a commendable effort is being made by the National Electric Light Association and by gasoline manufacturers and agricultural engineers to get the government to investigate the matter of power requirements and power costs on the farm. If electricity were used for all farm operations and included trucks and vehicles, the amount of power would assume proportions which would put a very different aspect on rural electrical service.

WORKSHOP LIGHTING.

An important article on this topic, abstracted from a foreign contemporary, appears in the *Digest* in this issue. It is striking evidence of the interest which has been aroused in the general campaign for good illumination, and is especially pertinent in the discussion of actual data obtained in both well-lighted and ill-lighted shops. Yet, however excellent data on proper illumination may be presented to the public eye, there is still some uncertainty about good examples being followed in this, as in all things. A certain type of works manager is quite content to let what he considers well enough alone, whether in manufacturing methods, lighting or precautions against accidents. Anything which means added cost is abhorrent to his economical soul. Fortunately, in most cases of this kind the punishment fits the crime and the unprogressive manufacturer finds himself, he knows not exactly why, at a disadvantage compared with his more wide-awake competitors. True enough, good illumination often costs no more than poor illumination, sometimes not so much. Every illuminating engineer can call to mind in his own practice cases in which the lighting has been greatly improved with a positive reduction in cost; yet the expense of making a change often determines whether or not it shall be made, and a bill for wiring fixtures and lamps sometimes looks forbiddingly large. It is not always the

worst lighted shop that is most difficult to reach with improvements. Beyond a certain point of inefficiency the results are so evidently bad as to force themselves upon the attention even of the most cautious and niggardly. It is the moderately bad establishment which is most difficult to reach, a place in which perhaps there is considerable expenditure for lighting, although the results are altogether unsatisfactory. If the lighting is such as not positively to interfere obviously with the workmen, and looks moderately bright, it is sometimes difficult to persuade those in authority that an improvement in illumination is necessary and desirable. Hence it is that it is so difficult to make legislative enactments which have really any effective force.

The notes on legal requirements for illumination in the article under discussion are deserving of comment. The governments of Holland and Switzerland seem to go furthest in the way of definite requirements for the illumination of workshops, and these, while well intended, show only too plainly the difficulties of legal interference. The Dutch requirement is not less than 15 lux (1.4 ft.-candles) for the following group of trades, evidently considered to require better lighting than usual: embroidery and sewing, mechanical knitting and quilting, draftsmanship, printing, engraving metal or wood, manufacture of instruments, clock and watch repairing, working in gold or silver or precious stones. For "other works requiring good lighting" a minimum of 10 lux (0.9 ft.-candle) meets the demand. Evidently the specified minimum is far too low, so low that the legal requirements can be met in a shop so badly illuminated as scarcely to permit of efficient work at all. The Swiss laws make some important specifications concerning the area and arrangement of windows and require "satisfactory" natural and artificial illumination. Presumably the lighting is to be satisfactory to inspecting officials, and if these are kept as thoroughly subdued in Switzerland as most factory inspectors are in this country one hardly has reason to expect a very high grade of illumination, save in cases in which an enlightened management realizes its economical value.

If any legislation on the subject of artificial illumination is to be effective at all, it must go very much further than in these instances in specifying the requirements in various classes of industrial establishments, or it must at least demand so considerable an amount of light as to insure good results provided ordinary intelligence is brought to bear upon the arrangement of the service. We are rather inclined to think that the latter method will in the long run prove the more effective; for if an industrial plant is required to spend enough energy in lighting to produce really good results if the expenditure is wisely directed, ordinary self-interest will soon be effective in producing at least a moderately good grade of illuminating engineering. The present strong tendency toward the introduction of various plans for increasing industrial efficiency is sure to be shown in improved illumination, provided enough light is demanded by law to make good illumination possible. Indeed, there is some reason to hope that the current desire for higher efficiency may bring about a great improvement in workshop lighting quite irrespective of any legal requirements whatever. There is more activity in good workshop lighting in this country than in any other phase of illuminating engineering, and the results justify the expenditure. We have yet to learn of any industrial plant the management of which has regretted its expenditure for good natural or artificial lighting, and improvements made thus willingly for the benefit of the industry are vastly more satisfactory than any that can be enforced by legislation.

The thing most important to present progress is an extension of the present campaign of education for better light, reinforced by legislation only when experience has shown that this is necessary to reaching the result. We have faith to believe that American works managers as a whole require no such goad along the path of progress. The illuminating engineers of the country ought to make it their business, as in no small measure they do, to get after the individual workshop and show what they can accomplish. Good illumination is an art which cannot be easily formulated into a set of simple rules. Two shops turning out a similar product may under their existing conditions require quite different treatment in the matter of illumination, treatment which cannot be specified in any formal enactment. Labor organizations, too, ought on their own account to serve as unofficial inspectors of illumination just as they do with respect to many other much less important matters. Most central stations at the present time can command at least a moderate amount of trained intelligence in illuminating engineering, and if their representatives make a point of getting in touch with the local industries and noting from personal inspection the conditions of illumination, a vast amount of good will be accomplished to the benefit of all parties concerned.

MAXIMUM DEMAND AND SIZE OF RESIDENCES.

The plan of estimating the probable maximum demand of a residence consumer upon the size of the house or number of rooms is increasing in popularity among electric service companies. It has been generally conceded for some time that the maximum demand of a consumer should be taken into account in making his rate. The maximum-demand meter has found a limited application for determining this maximum demand, but its first cost has kept it from general use in residence lighting business. For a number of years many electric service companies which have based their rates on the number of hours' use of the maximum demand per month have assumed that the maximum demand of a residence consumer is a certain percentage of the consumer's connected load. An objection to this plan is that it discourages the wiring of houses with a large number of lamps in closets, basements, hallways, etc., which lamps have little effect on the maximum demand of a consumer, as they are turned on for only a few moments at a time, but add very much to the popularity of electric lighting, because of their convenience. If the connected load is taken as a basis for estimating the maximum demand, the consumer with a large number of these convenient lamps about the house will pay a much higher net rate per kw-hour than one without many such lamps, even though the maximum demand of the latter consumer

may actually be about equal to that of the former. Obviously, there is no justice in such a method of figuring, and further it has a detrimental effect on the growth of the business because it virtually puts a penalty on some of the conveniences of electric light and encourages consumers to wire houses in a way which will not give them the greatest convenience. This is not favorable to general popularity of electric service and increase of business.

A method of overcoming these objections introduced in Detroit several years ago has gradually been finding favor with other companies, and the rate committee of the National Electric Light Association recommended in its last report the plan for residence lighting business. One of the recent notable additions to the list of companies using this system is that at St. Louis, as noted elsewhere. The plan in general is to estimate the consumer's maximum demand as being proportional to the size and general character of the house. The number of active rooms in the house is multiplied by a certain number of kilowatt-hours, which gives the number of kilowatt-hours the consumer must use before he exceeds the first portion of the bill. All energy used up to and including the first portion is billed at a certain rate, and the remainder or second portion at a much lower rate. The theory of the rate, of course, is to charge the consumer a high rate until he has paid the fixed and service charges incidental and proportional to his maximum demand. The rules of different companies vary as to what rooms are considered active, but usually they are the living-room, dining-room, kitchen, and certain bedrooms. Basements, halls and closets are usually excluded. Heating apparatus is not counted, as one of the objects of such a rate is to allow such apparatus to be used on the low-rate portion of the bill. It is interesting to note the progress of a residence rate which a few years ago was comparatively little known, but through its merit secured the indorsement of the N. E. L. A. rate committee above referred to.

THE RADIATION PROPERTIES OF INCANDESCENT LAMPS.

Some of the processes of nature suggest the idea that in the established order of things as known to us in this universe the principle of conservation is held in check by the judicious intervention of the opposite principle of dissipation. In other words, the notion suggests itself that so important is the principle of change among the things which are that dissipative activity is encouraged as the scavenger of effete and unguarded conservation. A universe of perpetual and unvaried retention of the *status quo* is, by universal consent, not that in which we grope our way, although such a universe is, in a certain sense, the easiest to conceive of. The only question for serious debate is whether the changes we perceive in the existing order of our environment are of the oscillatory character of those that animate the ocean wave, wherein each particle of water aims, as it were, perpetually at maintaining mean sea-level and yet passes through unending up-and-down movement in the quest, or whether the changes around us, while oscillatory, are also attended by a definite motion of translation, in a direction from which there can be no ultimate retreat or return. From the above outlined viewpoint, among all the protean forms of energy within our perception, heat is the great dissipative energy which ever tends to change and upset the existing order at any one part of our known universe. Energy can be kept conservatively locked up in the chemical form or in the gravitational form for long periods of time, and energy can be transformed through the medium of magnetism and of electricity without necessarily losing much hold upon it; but energy once it takes the form of heat dissipates and disappears from view.

The losses of electric energy in transmission are through runaway heat in wires or machinery. The main source of inefficiency in any process transforming energy is the thefts of heat. The heat engines in our central stations have a net efficiency, in ordinary service, of only some 10 per cent, because the heat runs away faster than it can be made to work. Before it can be all communicated to the boiler water some of it has escaped through the furnace walls and chimney. Before the expanding steam can give up the energy at the engine shaft it has escaped through cylinder walls and exhaust. There is always one comfort for the engineer who reflects upon the waste of energy in, and inefficiency of, a heat engine, and that is that the incandescent lamp is still worse. In spite of the enormous amount of discovery, invention and work directed to the perfection of the incandescent lamp, it is only recently that we have succeeded in obtaining lamps of about 1 cp per watt consumed, whereas it is estimated that an ideally perfect lamp could produce more than 50 cp per watt consumed, if the light delivered were in the most favorable part of the visible spectrum, and if there were no waste of energy in heat. If, however, the light delivered were white or of mixed colors, the ideal lamp of perfect efficiency might give very much less candle-power, depending on the particular colors in its spectrum. The incandescent-lamp maker in his turn may take comfort in the fact that so low a luminous efficiency as that of the best modern lamp leaves all the more room for possible future discovery and development.

The *Elektrotechnische Zeitschrift* has recently published an article, by Dr. Johannes Russner, on certain measurements of the luminous efficiency of incandescent lamps made thermometrically. The lamp, without socket, is immersed in a 30 per cent solution of ferroammonium sulphate, to a layer thickness of 30 mm (1.2 in.). Such a layer has the property of absorbing passing non-luminous heat almost completely, while at the same time it is fairly transparent to luminous rays. The elevation of temperature in the solution is measured with the incandescing lamp inserted in the same for a definite interval of time. The test is then repeated with the lamp coated in blackened tinfoil, to prevent the escape of light through the solution, and the increase of corresponding temperature elevation is noted. The difference of the two temperature elevations, corrected for outstanding sources of error, then enables the luminous efficiency of the lamp to be determined. The results, given in the article, go to show that the luminous efficiency of certain 115-volt carbon-filament lamps averaged 1.6 per cent, and that of certain 115-volt metallic-filament lamps averaged 4.5 per cent, or nearly three times as much.

A. I. E. E. Meetings.

At a meeting of the American Institute of Electrical Engineers, to be held in the Engineering Societies Building, New York, on Nov. 19, a bronze bust of Helmholtz, presented by Mr. Edward D. Adams, will be accepted with appropriate ceremonies. Arrangements have also been made for an address in behalf of the Verband Deutscher Elektrotechniker by Dr. Adolf Franke, who is at present in this country and who was a student under Helmholtz.

Following the presentation ceremonies a paper entitled "Magnetic Properties of Iron at Frequencies up to 200,000 Cycles" will be presented by Mr. E. F. Alexanderson, Schenectady, N. Y.

At joint meetings of the Chicago Section of the A. I. E. E. and the Electrical Section of the Western Society of Engineers the following papers will be presented: *Going Value*, by Mr. F. F. Fowle, on Nov. 22; *Protection of High-Tension Power Circuit Apparatus*, by Mr. James Lyman, on Dec. 27; *Public Utility Commissions*, by Mr. W. J. Hagenah, on Jan. 28.

American Mining Congress.

The fourteenth annual session of the American Mining Congress was held in Chicago on Oct. 24 to 28. This body was formed to foster and promote mining in all its various branches, but is "practical" rather than technical. A feature of the meeting was an address on "The Federal Government and Its Relation to the Mining Industry," by President Taft. Several electrical papers were down on the program, but they did not receive much attention, owing to the disposition of the congress to devote more time to important non-technical subjects, such as the conservation of natural resources, the situation in Alaska and the prevention of mine accidents. Gen. Irving Hale, of Denver, was to have presented a report on the use of electricity in metal mining, but was prevented by ill health. A paper by Mr. W. A. Thomas, of Pittsburgh, on "Electric Mining," was read by title and also one on "Electricity in Mining," by Mr. D. B. Rushmore, of Schenectady. Mr. Samuel A. Taylor, of Pittsburgh, was elected president of the American Mining Congress for the ensuing year.

The resolutions committee, made up of one man from each state, presented resolutions on various subjects connected with the mining industry. The resolutions which were adopted asked, among other things, that the Congress of the United States be requested "to provide for the establishment, under the direction of the Bureau of Mines, of a metallurgical experiment ore-test station or stations for the purpose of devising methods for the extraction of metals from low-grade ores." This action is one step, perhaps, in a movement looking toward a great extension in electrolytic processes of ore reduction, and therefore a greatly increased use of electrical energy in mining. Other resolutions asked the aid of the government in the maintenance of mining schools; expressed sympathy with inland waterway projects; asked the modification of the Sherman law to permit reasonable trade agreements between competitors in the mining business, provided there is no undue burden on the public; declared in favor of a just compensation to workingmen for injuries received while engaged in their duties; recommended greater publicity in relation to the undertakings of the American Mining Congress; disapproved of the "efforts of interested parties to have established national parks on the public domain wherein are known to exist deposits of oil, coal and other mineral wealth"; thanked the President and Congress of the United States for the creation of the Bureau of Mines, and asked the enactment of laws to bring about the opening up and operation of coal mines in Alaska for the "present and permanent welfare of the Alaskan people."

Despite the fact that little attention was paid to the electrical papers, there was evinced a friendly feeling toward the use of electricity in mining. The attendance at the mining congress was about 800.

Extension of Street Lighting in Chicago.

In planning the notable extension of 10,000 arc lamps for the street lighting of Chicago, Mr. William Carroll, city electrician, and Mr. E. B. Ellicott, electrical engineer of the Sanitary District, who have charge of the work, are endeavoring to locate the new lamps, after consulting the aldermen and other city authorities, where they will be needed most. The plans for this street-lighting extension contemplate underground feeders and overhead distribution lines outside of the central business district, the overhead construction consisting of 25-ft. steel poles supporting the lamps and one or two No. 6 weatherproof wires. There has been some criticism of these overhead wires in residence districts, and of course the engineers would prefer underground work throughout; but the cost of putting all the arc-lighting distribution wires underground is thought to be prohibitive.

However, it is not the purpose of the city to force the overhead wires on any neighborhood where the people consider them objectionable. It is the intention, for the time being at least, to leave out streets or neighborhoods where the property owners object strongly to the overhead wires, and proceed with the lighting plans where the people want the lamps badly enough to be willing to accept the overhead construction. But the city will place the wires underground on any street or system of streets where the property owners are willing to pay the difference in cost between underground construction and overhead construction.

Electrically Controlled Fender Chains for Panama Canal Locks.

Huge chains stretched across the lock chambers will protect the gates of the Panama Canal locks from being rammed when closed by any vessel that may become uncontrollable during the passage of the locks. After a gate thus guarded has been opened the chain itself will be dropped out of the way into a groove cast into the concrete of the lock chamber, allowing the vessel to proceed without restriction. Altogether twenty-four of these fender chains

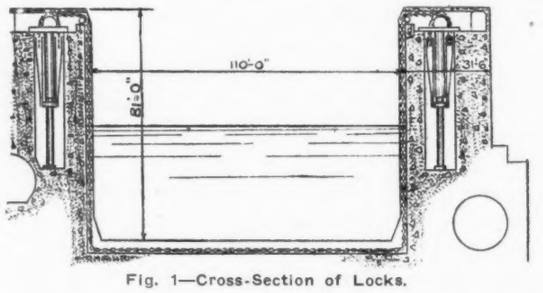


Fig. 1—Cross-Section of Locks.

will be employed at the Isthmus, the auxiliary guard gates, which miter in a direction opposite to the main gates, being protected in the same manner. The forty-eight chain-handling mechanisms required will be operated by water pressure, but controlled electrically by solenoid-operated valves and motor-operated centrifugal pumps.

Hydraulic cylinders will be employed to raise and lower the chains, an arrangement of sheaves giving 4 ft. of chain movement for each foot of travel of the pistons. Each system of cylinders will comprise a stationary 40-in. cylinder inside of which is a movable 38-in. cylinder in turn con-

taining a 25-in. fixed piston. The stroke of the cylinders will be 21 ft. 6 in., giving a total chain movement of 192 ft. from both sides of the chamber. By means of a remote-controlled solenoid valve, water pressure at 60 lb. per square inch, delivered by a centrifugal pump, will be turned into either the inner or outer cylinder, affecting the chain movement in the corresponding direction as desired. The motor-driven pumps will be started automatically by quick-acting switches which operate when required to restore pressure lost by leakage.

The most important function of the fender chains is to interpose a fixed but yielding resistance in case they are

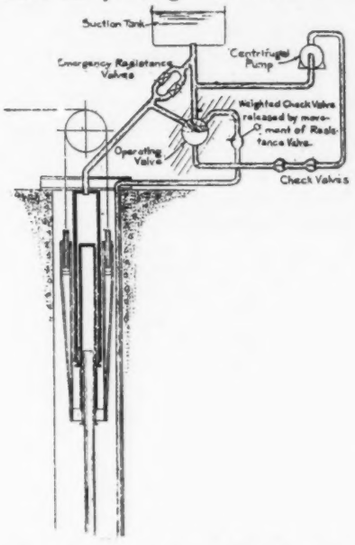


Fig. 2—Layout of Operating Machinery.

struck by a vessel, in this way arresting its movement without shock or damage and bringing it to a standstill as quickly as feasible. The water lines to the chain cylinders will be arranged with resistance valves so adjusted that if the ramming vessel imposes a stress beyond 750 lb. per square inch on the cylinders the chain will be paid out gradually by an automatic release until the ship comes to a stop. The emergency resistance valves will be arranged in parallel and so constructed that a constant stress of 750 lb. per square inch will be maintained on the cylinders. A 10,000-ton ship striking the chain is estimated to travel a distance of about 73 ft. before coming to a standstill.

Proposals have been asked for the equipment of these chain fenders and the bids will be opened at Washington Nov. 14.

Testing Motors for Panama Canal Lock-Valve Machines.

As mentioned in the *Electrical World* of May 4, 1911, page 1080, the Isthmian Canal Commission has purchased sample motors for testing with a view of purchasing 236 large electric motors to operate the valves in the locks on the Panama Canal. Allis-Chalmers, General Electric and Westinghouse motors have been secured for the test. A shed has been erected near the locks at Gatun, according to a recent issue of the *Canal Record*, and the motors are given tests for the climatic conditions on the Isthmus. Shop tests are now in progress in the United States, where the motors will be put through a working trial with one of the valve machines now ready at the works of the Wheeling Mold & Foundry Company. The object of the test on the Isthmus is to determine which type of motor will best stand the deteriorating effects of the climate. Upon their arrival the motors were placed in the dryroom of the storehouse at Gatun, and there the insulation resistance was measured at regular intervals for a week, and after storage in the dryroom it was measured further at intervals of twenty-four hours.

The tests include (1) the measuring of insulation resistance of the motors and the application of a 1500-volt high-potential test for one minute; (2) measuring of insulation resistance just prior to turning on steam and at intervals of six hours thereafter; (3) removal of hand-hole covers to admit saturated steam to the room so that the air is at a temperature of 50 deg. C.; (4) subject all motors to a high potential test of 1000 volts ten seconds every twenty-four hours. These tests will be continued for one week. If the data do not show any decided results the tests will be continued, but in a temperature of 75 deg. C. In addition the motors will be immersed in water at normal air temperature, and the insulation resistance will be measured just prior to immersion and after immersion. At intervals of six hours for two days just prior to removal from the water a high-potential test of 500 volts will be applied for ten seconds.

If these tests do not show conclusive results internal heat will be applied by running the motors on regular pressure, or at higher pressure to produce the desired heating effect. This test will show the rapidity with which the moisture in the insulation will be driven off, and will also render the insulation more porous and finally weaken it as to its insulating properties.

Investigation of a Fire in a Hydroelectric Generating Station.

On April 3, 1911, as recounted in the *Electrical World* of April 13 last, page 895, there was an unusual fire in the generating station of the St. Croix Power Company at Apple River Falls, Wis. This company is controlled by the St. Paul Gas Light Company, which receives the entire output of the plant. As stated in this journal at the time, the financial loss was not serious, amounting in all to about $4,000, but the fire was due to an unusual accident and an investigation has been made by Mr. William S. Boyd, 76 West Monroe Street, Chicago, an electrical inspector for the Underwriters, who has published the result of his findings in a pamphlet containing information of considerable interest.

The station building is brick and one story high. It contains four General Electric 750-kw, 3-phase, 800-volt, 60-cycle generators, each directly connected to a Victor turbine waterwheel developing about 1200 hp. There are two 65-kw exciters, also directly connected to a turbine in each case. Six 500-kw air-cooled transformers raise the voltage from 800 volts to 25,000 volts, and at this potential the output is carried on a pole line to St. Paul, where it is reduced for commercial distribution to 2300 volts. The plant is well built and was considered practically free from fire hazard and no insurance was carried. The value of the plant is approximately $140,000, of which $40,000 is apportioned to the building and $100,000 to the machinery.

During the day of April 3 three of the four generators were in service, carrying about 25 per cent overload. At the time of the fire they were developing about 900 volts and carrying about 25 per cent overload, at a speed of 300 r.p.m. Neither this slight increase in voltage nor the overload was considered dangerous, as during the ten years of operation no trouble was experienced from this practice. It is believed that the failure which caused the fire was not due primarily to this condition. The generators, which were installed about ten years ago, have revolving armatures, and on account of the low machine voltage the windings are quite heavy, consisting of copper bars ¼ in. by ¾ in. in section, insulated with varnished cambric and paper. These bars are held in slots by wooden wedges

fitted into grooves in the armature core, together with the usual wire bands.

About 5 p. m. the day operator, while seated at his desk in front of the switchboard, heard an unusual noise behind him, and looking about saw some flashing on the No. 3 generator. He thought the transmission lines were short-circuited and rushed to the circuit panels and opened the switches, but the flashing continued, and while he was considering the matter a copper bar thrown from the machine in trouble struck him in the back. Without further delay he rushed into the nearby machine shop and shouted for help to the superintendent, Mr. John Pearson. When Mr. Pearson hastened to enter the generator room there was a rain of copper bars and a splutter of molten copper against the switchboard, which convinced him that it would be fatal to attempt to get to the field switch, which was then in the thick of the disturbance. A moment later he noticed that the west end of the ventilator was on fire. The frame bin in which the clean waste was stored was also blazing and the high-voltage current was arcing from a broken disconnecting switch to its grounded iron support in the west end of the room. Generator No. 3 was afire, and resembled a huge "pin-wheel" in operation.

Within two minutes the waterwheels were shut down and the operation of the plant was stopped. Measures were then taken to fight the fire, first with chemical extinguishers and afterward with water. Some difficulty was experienced because the apparatus was not adequate. However, by using larger hose, which arrived in response to an appeal to the neighboring power house at the village of Somerset, the fire was finally extinguished by attacking it through holes cut in the roof. The heavy metal covering of the roof was considered to be a deciding factor in the saving of the plant, as the men in charge felt that with a combustible roof covering the fire would have burned through, gained great ventilation and been beyond control before the larger 2-in. hose was secured. At it was, the fire damage to the building was confined practically to the woodwork of the roof, and about $1,500 was spent in repairing the building. The repairs to the generator cost about $2,500, and within eighty-four hours from the time the fire was extinguished the entire plant was in full operation again, with the exception of the damaged generator.

Mr. Boyd concludes that the fire was caused undoubtedly by a short-circuit in the armature of No. 3 generator, which burned through its windings, together with the binding wires, permitting the hot bars and molten copper to be thrown off by the centrifugal force of the revolving armature. Some of this hot metal lodged in the ventilator and ignited the framework. The open bin for waste was also fired in this manner. What caused the short-circuit is not so well known. It seems probable that moisture from the ventilator gradually produced a weak spot in the insulation of the armature, which gave way and caused the short-circuit. Each machine was protected by 1200-amp fuses at the switchboard. Those on the No. 3 machine leads operated as soon as the short-circuit occurred and cut off the other machines from the trouble, otherwise there would have been danger of their burning out also.

To safeguard the generators against a repetition of the trouble, Mr. Cutcheon, general superintendent of the company, suggests that each machine be provided with a reverse-current relay designed to "kill" it and disconnect it from the busbar system the moment any energy starts to flow from the busbars into the machine. Such a contrivance would have saved the machine and probably would have prevented the fire. Mr. Boyd's conclusions, which are of some interest to operators of hydroelectric generating stations, are as follows:

1. Electrical machinery operating in multiple and having rapidly revolving parts carrying heavy copper conductors should be so equipped and controlled that a short-circuit within a machine will automatically stop generation in the defective machine and will disconnect it from the system.

2. High-voltage conductors and apparatus should be protected from possible flying particles of metal, preferably by inclosures of non-combustible material.

3. Switchboards should be so located or guarded that operators may manipulate controlling devices in safety.

4. Quick-acting valves controlling turbines should be so located in all hydroelectric plants that water may be promptly cut off by closing valves at a convenient point outside the generator room.

5. Ventilators or other roof structures of frame construction are a menace even on unexposed generating stations.

6. Power houses having roofs composed of combustible material are always liable to serious damage, especially where remote from fire protection; but where a wood roof is unavoidable the heavy mill type is least objectionable.

7. Roof coverings having good fire-retarding qualities are absolutely essential to the safety of power houses.

8. Frame air chambers for cooling transformers and similar construction work, creating concealed spaces which may obscure the presence of fire, constitute an unnecessary fire danger.

9. Combustible supplies, especially waste, whether clean or oily, should be kept in covered inclosures or tanks constructed of non-combustible material.

10. Standpipe and hose equipment with ample water supply and pressure to produce effective fire streams are indispensable to the safety of power houses having combustible roofs or floors or containing combustible material in quantities. This is particularly true of stations remote from public protection.

11. Ladders, fire axes, pike poles and crowbars should be provided for all power houses having roofs, roof structures or other construction work of combustible material.

12. Electrical generators and motors of comparatively low voltage rating are more liable to damage by heat than by water where small fires are concerned.

13. Cool, determined, resourceful leadership, coupled with good judgment, is the most important factor in the saving of property in time of fire.

Tungsten-Tube Furnace.

The great advances made recently in our knowledge of the physical properties of pure tungsten in connection with the development of the tungsten-filament lamp have suggested the substitution of tungsten for platinum as a resistor for electric furnaces. Tungsten has for this purpose the two great advantages of very high melting point and relatively low cost, but, on the other hand, must be protected from oxidation, which is unnecessary with platinum.

Electric furnaces with tungsten resistors are now in commercial use in the manufacture of tungsten lamps and two furnaces of this kind, one a crucible furnace, the other a tube furnace, were described in the recent American Electrochemical Society paper by Messrs. R. Winne and C. Dantsizen. In their tube furnace they use an aluminum tube wound with ductile tungsten foil.

Quite a different construction (though possibly of older date) of tungsten-tube furnace is described in a patent issued Oct. 3 to Dr. William D. Coolidge, of the General Electric Company, and an active contributor in the development of the new tungsten lamp. He employs a solid tungsten tube, surrounded by some non-carbonaceous heat insulator, like calcium oxide, alumina, thoria, etc. This insulating mass is in turn surrounded by a layer of coke, and the whole is inclosed in a metal box. To prevent oxidation of the tungsten tube an atmosphere of hydrogen or some other inert gas is maintained in it.

The tungsten tube is made of a mixture of metallic tungsten and an alloy of bismuth, cadmium and mercury.

This gives a plastic mixture which can easily be brought into the form of a tube, and the bismuth, cadmium and mercury are later driven out by a special heat treatment.

Instead of pure tungsten the tube may be made of a mixture of tungsten with thoria, which has several advantages. It has a greater electric resistivity than pure tungsten, thus permitting the use of higher voltages for operation of the furnace; the thoria serves to stiffen the tungsten tube, and finally it is easy in this way so to charge the refractory tube that no tungsten is exposed to the direct oxidizing action of the air. To obtain this result it is only necessary to heat the tube in air and thereby oxidize the tungsten on the surface, which oxide is vaporizing as produced. There remains a porous shell of thoria completely enveloping the homogeneous inner portion of mixed tungsten and thoria. Such a tube is relatively inert, and at the high temperatures at which it is used it does not tend to stick or become welded to any articles which are placed in it for treatment.

Color Correction for Light of Mercury-Arc Lamp.

A patent issued to Dr. C. P. Steinmetz on Oct. 17 contains much interesting information concerning methods that may be employed for introducing red rays into the light obtained from mercury-arc lamps. For this purpose use can be made of potassium, sodium, lithium, rhubidium, indium or thallium, combined with the mercury mass. However, these substances vigorously attack the glass envelope and form a black deposit on the inside thereof.

This difficulty can be overcome by introducing the substance as an anhydrous iodid or other halogen salt, rather than in its natural condition. The same beneficial results can be attained by allowing the color-modifying substances to react upon the inner walls of the glass inclosure to form transparent products. By the use of the meta-silicate of lithium this result can be accomplished. In order to reduce the potential necessary to start the arc the inventor incloses the mercury in a glass vessel with hydrogen exhausted to a fairly high vacuum, and provides for an excess of iodin in the color-modifying substance by the addition of free iodin or of iodid of mercury. A white light can be produced by combining the violet, blue, green and yellow of the mercury light with the orange and red of sodium and lithium.

The Treasury Department and the Illuminating Engineer.

At a well-attended meeting of the Electric Club of Chicago, held on Sept. 27, during the convention of the Illuminating Engineering Society in that city, Mr. L. B. Marks, who was the first president of the Illuminating Engineering Society, made a brief talk that aroused a great deal of interest. He said that he would take advantage of the opportunity to "fire one shot," and that shot consisted in a criticism of the Treasury Department of the United States government for its contemptuous attitude toward illuminating engineering in designing and maintaining public buildings.

The speaker said that the salaries of the men responsible for the lighting plans of public buildings under the control of the Treasury Department has been reduced to a point where they hardly afford a living wage. A dozen men could be named, he said, who were really competent to design illuminating engineering of a high order and who had left the Treasury Department because of the insufficient remuneration. Mr. Marks made a plea for the diffusion of education that will make insistent a demand for better illumination of public buildings throughout the United States. The Illuminating Engineering Society contemplates such work as one of its objects, but it hasn't scratched the surface yet. It is a fact that the Treasury Department does not recognize the simplest principles of good illumination. In the Treasury Department building itself at Washington there are bare lamps in the field of vision. The condition of affairs in this particular is disgraceful. Individual illuminating engineers cannot get a hearing before the department, and the co-operation of all electrical organizations is needed to remedy this condition of affairs.

Mr. E. L. Elliott, of New York, who was the next speaker, said that the government's lack of attention to illuminating engineering had been a little overstated by Mr. Marks. The new office buildings of Congress in Washington were cited as examples where the government had employed illuminating engineering advice. To Mr. Elliott it appeared that the fact that illuminating engineers were too valuable for the government to employ was rather encouraging. The government hires cheap help and cannot compete with private enterprise. The speaker urged greater co-operation between architects and illuminating engineers.

In answer to a question put by Mr. James H. Delany, of Chicago, Mr. Marks spoke briefly of the relations of architects and illuminating engineers. He referred to the late Mr. Carrère as an able architect in New York who might perhaps have come to a realization of the importance of illuminating engineering had he lived. Mr. Marks added that Mr. Elliott was mistaken in supposing that the Treasury Department had employed illuminating engineers. Other departments of the United States government have done this, but the fact is that the Treasury Department has charge of nearly all federal buildings throughout the country, and it was this department that he was criticising; other departments of the government are more advanced. For instance, in the State, War and Navy Building in Washington the advice of illuminating engineers has been followed, although the Treasury Department officials have laughed at the idea. It is a fact that that department does not appreciate what the illuminating engineer does.

Mr. Marks also complained that in some cases where the illuminating engineer is called in he is simply employed to design an electric system and to locate the outlets, some other person selecting the fixtures. Such a procedure spoils any consistent plant for a system of illumination. Reverting to the Treasury Department's attitude, the speaker said that the condition to which he referred was a standing joke. It is "up to us," he said, to remedy the existing conditions. Engineers have offered their services free of charge to the Treasury Department, so that the question of cost does not enter into the matter. Mr. Marks said that he was speaking for what be believed to be the good of the public; he was not representing any society or any firm of engineers.

Mr. T. G. Grier, of Chicago, in an amusing speech said that it might be the duty of salesmen to convince the Treasury Department that it should buy the proper kind of materials for illuminating engineering.

Mr. F. J. Pearson, former president of the Chicago Section of the Illuminating Engineering Society, said that what Mr. Marks had said was but too true. The government seems to be continually making experiments in the erection of its public buildings. Probably the principal cause of this state of affairs is the fact that the people seem to have lost sight of the fact that the office of supervising architect of the Treasury Department is one of much importance and dignity. The appointment to this office should not be a political one, but so long as it is and so long as the engineering public acquiesce in the situation the condition complained of will probably continue. Certain materials are exploited in the designing of public buildings, regardless of the engineering principles involved. Mr. Pearson noted the fact that these conditions do not obtain in the War or Navy Department or in the Bureau of Standards, because these departments are administered by men of engineering train-

ing. In particular the speaker commended the work of the Bureau of Standards, making especial mention of Dr. Rosa and Dr. Hyde.

In conclusion Mr. Marks repeated that he was not finding fault with the State, War or Navy Department or the Bureau of Standards. It is the Treasury Department, however, that has charge of the thousands of public buildings scattered throughout the country, and it is to that department that his criticism is directed.

Production of Electrolytic Zinc in the Metallurgy of Complex Ores.

In a paper describing the Malm process for the recovery of metals from complex ores, read before the recent American Mining Congress in Chicago by Col. A. G. Brownlee, of Idaho Springs, Col., an interesting reference was made to the electrical features of the process. The ore is subjected to the action of chlorine gas and to various processes, so that chlorides of all the metals contained in it, as gold, silver, copper, lead and zinc, are formed. After various treatments only zinc chloride in solution is left, and from this the moisture is removed, the residuum being fused and run into electrolytic cells. Here electricity is applied, and the zinc is deposited in metallic form. The zinc cells are operated at a temperature of about 450 deg. C. The various precipitates of gold, silver, copper and lead are separately collected in filter presses, and the molten metallic zinc is tapped from the electrolytic cells at regular intervals.

From 60 to 70 per cent of the cost of operating this process goes for electrical energy. Direct current at low voltage is used for the electrolytic work, which applies to zinc only, and the consumption of electricity varies with the zinc or zinc-equivalent contents of the ore. In practice recovery has been made of 14.2 lb. to 14.4 lb. of zinc per hp-day. With energy at $50 per hp-year it is figured that the cost of converting zinc chloride into metallic bars of zinc amounts to but a little over a cent a pound of the metal produced. Electrolytic zinc made abroad is sold in New York at a premium as high as 2.5 cents a pound over spelter, which is an impure product. It is asserted that by the Malm process as a whole not less than 90 per cent of the values of all the metals in refractory ore may be recovered. It is said that the process promises to become as important a factor in the extraction of all the metals in complex ores as the cyanide process has proved in the treatment of straight gold ores.

Suburban Electric Service.

Mr. John G. Learned, general contract agent for the North Shore Electric Company, of Chicago, addressed the Electric Club of that city on Oct. 18 on "Central-Station Business in the Suburban Districts." Mr. Learned exhibited a large wall map showing the seventy-two cities and villages in which the company has franchises. (See *Electrical World* of Feb. 23, 1911, pp. 479-485.) The territory served by the North Shore Electric Company covers 1200 sq. miles, and surrounds Chicago on the north, west and south. Fifty-two of the seventy-two towns served have street-lighting contracts with the company and the latter is pumping water for fourteen municipalities. The area tributary to the company is largely composed of farming land and the company is gradually picking up some business from farmers, although so far the customers of this class are mostly "gentlemen farmers"—that is, rich Chicagoans who desire to use electricity on their country places. The company has twelve display rooms in different communities and advertises in thirty-four weekly and two daily newspapers.

Owing to the fact that lamps and motors are supplied from the same alternating-current circuits the company is rather strict in its requirements relating to motors. However, single-phase motors up to 5 hp are taken on the lines without question, unless there is some special objection, as in the case of pumping motors at the end of long lines. Motors of 5 hp to 7½ hp are taken on, provided their operation will not affect the lighting regulation, which the company looks after very carefully. Non-inductive starters are required. For sizes from 7½ hp to 35 hp squirrel-cage motors are stipulated, and above 35 hp all motors must be of the slip-ring type. Furthermore, all motors must be provided with no-voltage release apparatus.

Free renewals are made in the case of standard carbon lamps. The company does not, however, make deliveries of lamps, but requires the customer to apply at certain established stations and in some cases on certain days when the lamp agent is traveling through that section of the territory. An allowance of 20 cents is made for each burned-out carbon lamp supplied by the company and tendered in exchange for tungsten or other special lamps. The company is considering the use of Gem lamps instead of the standard carbon lamps.

Thirty solicitors are employed by the company, which has 30,000 customers. The various electrical household appliances, such as washing machines, flatirons, etc., are of great assistance to the company in going after new business, and the North Shore people make a point of cooperating with the manufacturers of apparatus of this description. The electric fireless cooker has not proved a success so far, but washing machines are in demand, while electric flatirons are very popular, there being one in service to every five customers.

Among those taking part in the brief discussion were Messrs. Frank F. Fowle, William M. Connelly, R. M. Gaston and H. E. Niesz.

Reactance in Alternating-Current Circuits.

For the subject of his annual lecture at the joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers in Chicago on Oct. 25 Dr. C. P. Steinmetz chose "Reactance in Alternating-Current Circuits." Mr. J. G. Wray presided at the meeting, and Mr. B. J. Arnold introduced the speaker. Dr. Steinmetz contrasted the unfavorable conception of reactance formerly held by engineers with the uses which have been found for it in later years, and he considered each of the uses in turn, concluding with a warning against the possible danger of using reactance without a full understanding of its characteristics.

There has been a general impression that reactance in alternating-current circuits is objectionable, but, on the other hand, engineers are now installing it in large stations to insure safety of the system. Reactance became of importance with the introduction of alternating-current distribution following the appearance of the transformer in 1886. It was observed that the drop in alternating-current circuits was far in excess of what it was in direct-current circuits. This phenomenon is due to self-induction, and it was only by the conception of reactance—an apparent resistance that consumes voltage—that measures were taken to correct this defect. Reactance differs from ohmic resistance in that the voltage consumed is not in phase with the current, and as the result the reactance does not consume power.

It took a number of years to develop this conception, and it was not until 1893 that engineers were able to grapple successfully with the situation presented. It was the problem of the seven years from 1886 to 1893 to control and eliminate reactance drop by designing transformers and

other alternating-current apparatus with that end in view. By using conductors of moderate size and by employing lower frequencies the reactance drop was brought under control, and this made alternating-current distribution practicable. However, direct current is still in use where there are large amounts of power to be distributed in congested districts, as in New York and Chicago, for example.

Early transformers had from 15 to 20 per cent reactance, but the reactance was brought down gradually until it is no longer a formidable characteristic of transformers, now reaching perhaps 1½ to 2 per cent. A corresponding development took place in the generators, with the final result that reactance ceased to be an enemy of the alternating-current system. Modern designers, however, have gone beyond the point where reactance is held to be harmful, for reactance, even excessive reactance, is not an unmitigated evil; there are cases where it is useful. Even in the early years it was used to impose voltage regulation by what is now known as phase control. If the phase of an alternating current is varied the effect of the reactance voltage can be correspondingly varied. Resistance drop always increases with the increase of load. By changing the phase of the current it is possible to secure control of the voltage. This can be done in synchronous machines by a change of excitation, and this has become the standard system of voltage regulation in long-distance railway systems. In some large transmission systems in the West operation is only possible by the use of synchronous machines, synchronous motors being also used at the centers of distribution.

The first use of reactance for voltage regulation was made in generators and lines. Obviously this method is useful only where each synchronous motor has its own generator to act upon. The reactance of lines alone is not sufficient to give regulation. At the present time standard long-distance railway systems make use of reactive coils. Some ludicrous situations have arisen from the modern applications of reactance; transformers, for instance, are specified to be of less than 2 per cent reactance, while the engineer then turns around and buys 15 per cent reactive coils for his secondary circuits.

Alternating-current generators are now operated satisfactorily in parallel. Modern steam-turbine 25-cycle alternators have reactances sometimes as low as 2 to 3 per cent. They are operated in parallel very successfully, but when they are operated in multiple hunting is apt to appear, with resulting instability.

The resistance in the machines themselves is small, perhaps only a fraction of 1 per cent, but when cables from other power houses in a network add their resistance the synchronizing power of the small reactance in the machines may vanish. In this case reactive coils must be used. Such synchronizing reactances are a necessity whenever the resistance between the machines is not small compared with the reactance.

An electric arc cannot be operated on a simple supply voltage; resistance or reactance is required in the circuit. In an alternating-current arc circuit a power-factor above 75 per cent can never be reached unless resistance is used. Here reactance is used to give stability.

An entirely different use of reactance is made when it is employed as a protective device. It is supposed to act as a barrier, keeping high-voltage disturbances out of the station by use of the so-called choke coils. But this use of reactance has been less frequent of late, for it has limitations and cannot be used promiscuously. It protects only at frequencies which are very many times higher than the normal frequency. It will not act as low frequency. Reactance to protect effectively must have no appreciable capacity. Thus the frequency range of protective reactance is limited, and, furthermore, the device must be designed so that it will have negligible capacity. Again, these protective devices serve not only to keep high-voltage disturbances out of the station, but also to prevent any disturbance of this sort originating in the station from getting out. The rule works both ways. The device is useful if properly installed and applied, but the situation of the station and line must be studied.

Quite recently another application of reactance has been made in huge high-power generating stations where hundreds of thousands of kilowatts are developed. The whole system here has extremely small resistance and reactance; any disturbance is therefore liable to be dangerous. Switches, which must be of reasonable size and cost, cannot be relied upon to open circuits carrying very large amounts of power. Therefore reactance is introduced, say 8 to 10 per cent, which can be used as a safety device and placed in the generator or the transformer, or externally applied. Experience shows that in large transformers, even of 25 cycles, it is possible to give 8 per cent reactance, which is sufficient. In the generator the case is different, for it is practicable to get only 3 or 4 per cent internal reactance, and it is usually more economical to add what is needed in the shape of a reactive coil or step-up auto-transformer. At this point Dr. Steinmetz gave a brief exposition of machine design to show the maximum-economy point in armature reaction.

In the huge units of the great modern power stations regulation is not so important as formerly. If, for instance, the output is 100,000 kw a variation of 10,000 kw thrown on or off is not so serious a matter as in the case of a station rated at 20,000 kw or 30,000 kw. External reactance has, however, a less unfavorable effect on regulation than has armature reactance.

In concluding, the lecturer called attention to one more point in relation to the use of reactance in alternating-current circuits. It must be remembered, he said,, that where there is reactance in a circuit energy is stored in the magnetic field of that circuit. Reactance must always be considered as energy storage. It represents a momentum, so to speak. Therefore currents must not be ruptured instantly where there is appreciable reactance. One of the main advantages of the oil switch is that it opens at zero current. Where there is high reactance engineers and station operators must guard against setting stored energy free at too rapid a rate. Reactance is indeed required, but it must be realized that the stored energy which it implies must not be let loose in a destructive manner; otherwise that energy may run wild and do serious damage.

In answer to questions asked by Mr. G. W. Cravens and another gentleman, the speaker gave some further explanation of the characteristics of resistance and reactance. While reactance used with generators can vary over a considerable range, it should not be too much or too little. In railway practice from 15 to 18 per cent of reactance is used coincident with from 2 to 10 per cent of resistance. In general it may be said that the reactance should not be over 40 per cent of a total circuit, or less than twice the amount of resistance. Iron cores are not placed in the external reactive coils used with generators because they are uneconomical. If iron cores were used they would have to be operated at low density, and they would be too large and heavy to be practicable.

Uses of the Amp-Hour Meter.

Before the Car Lighting Club of Chicago on Oct. 18 Mr. Robert C. Lanphier gave an illustrated account of the amp-hour meter, which, he said, has a wide field of application for various services where the watt-hour meter is not available. Amp-hour meters are used with storage batteries on electric vehicles, in central-station service, in central energy telephone systems, for train-lighting service and in control of electroplating operations. The Sangamo amp-hour meter was developed something over three years ago at the suggestion of Mr. Ernest Lunn, of the

Commonwealth Edison Company, Chicago. It is practically a Faraday-disk or mercury-motor meter. The mercury chamber is shaped like an invertible inkwell, preventing spilling of mercury in any position. A "differential shunt" causes the meter to run slower on battery charging than on discharging, thus giving to the battery automatically the necessary percentage of overcharge, say, 15 per cent, every time it is charged. A "resetting device" permits setting the indicating hand ahead, by any desired percentage, when a periodical overcharge is wanted. A stop-charge contact opens the charging circuit by actual amp-hours input.

For straight storage-battery train lighting the amp-hour meter is used under practically the same conditions as on electric automobiles. With axle-drive equipment a new arrangement will allow the use of the meter not only to stop the charge at the proper time and to indicate the condition of the battery with respect to charge, but also to serve as a controller, operating through relays, to transfer the battery from charge to discharge at the proper time and to cut off the generator at full battery charge.

Mr. Lanphier described the compensated type of amp-hour meter, which is speeded up on discharge above the correct speed at any given load, so as to compensate at each load for the reduction in effective capacity of the battery at that particular discharge rate. Another feature, and a new one, is the distant-operated dial device by which the meter can be placed at one point on a railroad car or electric automobile while the dial can be placed at any other desired point, the only connection being a small cable. The speaker also described the method of using the meter with stationary batteries in central stations.

A special use of the amp-hour meter is in connection with the Delco system of cranking, lighting and ignition used on Cadillac gasoline automobiles this year. Here the meter acts as a controller to open and close the field circuit of the generator, so that the battery is never allowed to become overcharged and, by a further adjustment, the battery cannot be discharged to too great an extent. Amp-hour meters are also used on submarine boats of the United States Navy in connection with storage batteries and should prove of considerable value in keeping the batteries in a fully charged condition when a boat has to run submerged.

A peculiar form of amp-hour meter has been built by the Sangamo company for the Interborough Rapid Transit Company, the meter being, in fact, not an amp-hour meter, but an amp-squared-hour meter. This meter is intended to record on the dial the product of amperes squared by time instead of amp-hours merely. Two of these meters are being used for testing the load on distributing cables of the Interborough company, for with the resistance of a cable known the product of the meter reading in amp-squared-hours by the resistance gives the total energy lost in any cable during the period over which the load has passed through the meter. This is a very interesting and novel way of arriving at the energy losses and much more accurate than any method of taking voltage drop between distant ends of the cable with a varying load.

Messrs. A. J. Farrelly, J. B. Gray, C. R. Gilman, H. W. Young, G. B. Colegrove, F. E. Hutchinson, G. W. Cravens, C. L. Williams and others took part in the discussion. Several of the gentlemen mentioned are car-lighting engineers and they spoke in favorable terms of the use of the amp-hour meter in connection with storage-battery train lighting. No one else volunteering, Mr. Lanphier was asked to "knock" his own instrument. He said that some difficulty had been experienced from vibration of the meters in railroad service, but this had now been corrected by the use of lock washers. Occasional trouble has arisen from the cracking of jewels, but this has not occurred very often. Trouble with the gear ratio may be obviated by rigid shop inspection.

Illinois State Convention at Rockford.

More than 100 central-station men were present at the annual convention of the Illinois State Electrical Association, held at Rockford Oct. 24 to 26, the total registration, including associate members and manufacturers' representatives, bringing the number of those present up to 300. In connection with the convention an electric show was held in the Rockford Armory, where a number of electrical and local manufacturers made exhibits of interest to the central-station visitors and the general public.

SOLICITING MOTOR BUSINESS.

With President W. G. Austin, of Effingham, in the chair, the first convention session was opened Tuesday afternoon with an illustrated discussion by Mr. George B. Coleman, of the Rockford Electric Company, on the subject of local motor applications and methods of obtaining motor-drive business. Mr. Coleman demonstrated the use of photographs of typical installations for convincing prospective customers of the benefits of motor drive, and displayed forms of letters with curve sheets and illustrations attached, used for soliciting this class of business. The stereopticon was also employed to exhibit further applications of motor drive.

On Wednesday morning Mr. John G. Learned, of the North Shore Electric Company, Chicago, read his paper giving suggestions for the sale of energy for motor service. While the motor-service salesman, said the speaker, preferably should be equipped with a technical education, this very fact may hamper him with engineering details, confusing the customer and delaying the signing of the contract. For this reason the commercial instinct should predominate, and great care should be taken in the selection of men, since a poor representative can do much harm in the course of a very few visits to a prospective customer. Mr. Leonard outlined the proper method of approaching a prospective customer, advising the salesman to make a thorough study of the field in which he is working, together with the personnel of the various firms he is to visit. The speaker exhibited forms used by the North Shore Electric Company for itemizing isolated-plant costs and for advertising its service. Mr. Learned also brought out the beneficial effect on a person who receives confirmation of the central station's statements by electrical-appliance salesmen apparently having no interest in the central station's affairs. The speaker urged such co-operation, although on a non-competitive basis as far as the sale of motors is concerned, leaving the choice of the particular make to the customer's selection.

A paper by Mr. T. P. Pinckard, of Peoria, Ill., was next read by Mr. R. S. Wallace. The author urged the importance of eternally keeping after prospective motor customers to increase the central station's motor load, and pointed out that this work of conversion of isolated plants is gradually becoming easier. Usually the obstacle which causes slow-moving negotiations is the incredulity of the prospective customer, rather than his antagonism. Mr. Pinckard urged the careful study of the costs of production of the isolated plant, taking care to inspire confidence in the superior quality of central-station service.

Mr. A. C. Martin, of the Rockford Electric Company, followed with a paper on the same subject, in which he spoke of the need for removing the prejudice that often exists against purchased energy, which is on this account alone improperly believed to be more expensive than private-plant service. An excellent method, he mentioned, is to secure letters from the company's present motor users. These copies, he said, should be kept in a loose-leaf notebook and carried by the salesman for the ready reference of other prospective customers. On his initial call the salesman should always omit all reference to the sale of service, but finally bring the talk around to the subject of

the manufacturers' present equipment, its defects and the possibility of making an indicator test of the plant. The correct cost of operating an isolated plant, said Mr. Martin, is after all the most important factor entering into the closing of a contract. Definite estimates should always be included of the cost of heating, together with suggestions for improvements in motor arrangement which will give a more efficient drive.

The subject was discussed by Dr. E. J. Berg, of Champaign, and Messrs. Charles A. Munroe, of Joliet; Frank J. Baker, of Chicago; A. C. Martin, of Rockford; G. B. Coleman, of Rockford; C. W. Pen Dell, of Chicago; John F. Gilchrist, of Chicago; H. J. Pepper, of Champaign; E. B. Hillman, of Quincy; H. A. Foster, of Fairbury; F. M. Sinsabaugh, of Mount Vernon; L. R. Spaulding, of Mount Morris; E. Macdonald, of Lincoln; E. O. Brown, of Elmwood; E. J. Condon, of Harvard, and David Davis, of Litchfield.

SALE OF ELECTRICITY TO FARMERS.

A paper on "The Sale of Electricity to Farmers," prepared by Mr. E. L. Brown, of Elmwood, Ill., was read by his son, Mr. E. O. Brown. It described the local system, which comprises 30 miles of transmission lines connecting eight small towns and incidentally supplying about fifty farms with electric service for lighting and motors. The Elmwood plant and plan of supplying electricity to farmers were described in the *Electrical World* of March 2, 1911.

Mr. R. H. Abbott, of Petersburg, Ill., followed with a paper describing his own service to farmers along the route of his 16,500-volt, single-phase transmission line. High-tension transformers step down to 2400 volts for primary distribution. All transformers, poles, lines, lightning arresters, etc., are owned by the farm customers, each of whom pays a minimum charge of $2 per month.

Mr. H. W. Bullock, of Eureka, Ill., presented a description of the supply of central-station service to farms along his transmission lines into Roanoke and Metamora. Besides the lighting of the houses, and of dooryards, barnyards and feedyards by tungsten lamps on poles, motors are here used for agricultural purposes, such as pumping water, grinding feed, sawing wood, elevating grain into cribs and driving cream separators, churns, washing-machines, sewing-machines and fans.

A paper by Mr. J. G. Learned, of Chicago, referred to the report of the committee on electricity in the rural districts, appointed by the National Electric Light Association. The speaker urged education of the farmer to the point where he will realize the advantages and economy of electricity. The farm business, he said, is usually "off-peak," and in respect to its diversity factor will pay the central station. Mr. Learned's paper included a list of farm applications of motors, together with an enumeration of the horse-power rating of motors required to drive various farm machines.

Mr. E. P. Edwards, of the General Electric Company, Schenectady, N. Y., discussed the future of electricity on the farm. There are 30,000,000 horses and mules in this country, said Mr. Edwards, 90 per cent of which are employed in agriculture. In spite of the attention given to improving crops and to conservation on the farm practically no data are yet available on the best forms of motive equipment which can be used and the cost of performing the simplest farm operations. It is known, however, that about 10 hp-hours are required to plow an acre of ground. Manual labor on the farm is paid an average of 11 cents per hour, and, as such labor is equivalent to about ⅛ hp, human energy is seen to be worth 88 cents per hp-hour. The average cost of an animal hp-hour is 8 cents, including interest, maintenance and depreciation of stock and equipment. Mr. Edwards urged that the United States Department of Agriculture and the various agricultural colleges investigate this highly important subject of the cost of power for farm services and the applications of electricity to such operations, although in the meantime, he said, private manufacturers are taking up the testing of practical farm applications. Even assuming that only one-fourth of the farms of this country are reached by central-station lines, Mr. Edwards pointed out the enormous significance to the central-station business of this load. The subject of farm supply was further discussed by Messrs. Theo. Bass, of Farmington; H. J. Pepper, of Champaign; C. W. Pen Dell, of Chicago; W. G. Austin, of Effingham; E. J. Negley, of Canton; S. B. Cushing, of Chicago; F. J. Baker, of Chicago; E. J. Condon, of Harvard, and J. J. Frey, of Hillsboro, and by Dr. E. J. Berg, of Champaign.

MUNICIPAL WATER PUMPING.

Mr. E. Macdonald, of Lincoln, Ill., presented a paper on the subject of "Pumping Water for City Supplies." The paper outlined examples of costs of pumping in small towns and the saving to the municipality over operating its own steam pumps. The cost of such pumping service, said Mr. Macdonald, varies from 5 cents to 2 cents per kw-hour, and is 7 cents or less per 1000 gal. pumped. Tests of the 75-hp motor-driven pump in use at Lincoln have shown that it operates with about 3 tons less coal per 1,000,000 gal. pumped than is required by either of the steam pumps.

Mr. F. J. Baker, of Chicago, pointed out objections to contracts on a basis of payment per 1000 gal. pumped, since depreciation of machinery and equipment and lowering of the water level in the wells may change appreciably the margin of profit of the electric company. Mr. Baker observed that in instances where the company gets the water pumping the matter of a municipal lighting plant is usually thus settled, since agitation for a municipal electric plant usually centers about the city water-works. For this reason, he said, central stations could afford to take city pumping at reduced profit or at none. Mr. W. J. Kyle, of Chicago, asserted, however, that the Massachusetts Public Service Commission has ruled that a city must pay the same price for its service as any other customer. Mr. E. J. Condon, of Harvard, urged that the municipal contracts be always taken at a profit and that on account of greater simplicity service be charged for on the basis of water pumped.

Mr. E. Macdonald, of Lincoln, pointed out that water meters are usually inaccurate and that the principal reliance should be placed in electric meters. Pumping equipment, he added, should be maintained by the company, since city officials are likely to be very careless in the upkeep of apparatus, thus contributing to the cost of water pumped under contracts on a pumpage basis. Mr. C. W. Pen Dell, of Chicago, described the operation of automatic motor-driven municipal pumping plants operated by the North Shore Electric Company, in which both the deep-well and centrifugal high-duty pumps are started automatically, without attendance, to maintain an ample reservoir supply. In case of fire the two centrifugal pumps are connected in series for double pressure. Mr. Charles Munroe, of Joliet, advised the conversion of municipalities to the payment of a fair rate for energy rather than the taking of this business at cost.

UNIFORM ACCOUNTING.

A paper by Mr. F. W. Gregory, of East St. Louis, Ill., read in the author's absence by Mr. R. C. Hardy, opened the Wednesday afternoon session. The author warned against the conservative practice of charging to operating expenses many legitimate capital expenditures. This not only deceives the management as to the profits, but keeps the book cost of a property down to a figure sometimes less than the actual replacement cost. A public-service commission investigating such a company's affairs could hardly allow credit or returns on these legitimate investments where so classified. Using the eight main divisions of the N. E. L. A. scheme of classification of accounts, both the largest and the smallest companies, he said, could obtain a

fair comparison of their unit costs. As a practical point Mr. Gregory suggested the use of loose-leaf ledgers in case a system of uniform accounting is to be adopted, later subject to the regulation of a commission. In closing, the author urged the adoption of the national association's schedule, which is now being used by a number of companies throughout the country.

Mr. H. E. Addenbrooke, of Chicago, followed with an analysis of the National Association's classification of accounts, and pointed out the benefits resulting from a uniform system of accounting. Mr. Addenbrooke's paper included analyses of expense, income and investment accounts applicable to the smallest as well as the larger companies. In the discussion which followed Mr. F. J. Baker, of Chicago; Mr. R. S. Wallace, of Peoria, and Mr. E. W. Smith, of Kewanee, testified to the excellent results expected of the N. E. L. A. schedule, which eight Illinois companies have adopted during the past year. Mr. Baker also detailed an account of the North Shore's "morgue" for filing photographs and accurate descriptions of obsolete apparatus replaced during the reconstruction of stations. Such descriptive data, he thought, would be of value in demonstrating to a commission the equipment rendered obsolete in the development of a given system. In answer to a question from Mr. David Davis, of Litchfield, Mr. Addenbrooke said that some states permit companies to capitalize the loss entailed due to the discount on their bonds, while others allow charging off this amount. Mr. Baker observed that this cost should be charged to a suspense fund and equalized over the life of the bonds.

PROGRESS IN ELECTRICAL ENGINEERING.

One of the treats of the convention was an address by Dr. Ernst Berg, professor of electrical engineering at the University of Illinois, on the subject of "Recent Progress in Electrical Engineering." Professor Berg referred briefly to the periods of development about 1893 and later in 1905, observing that at the present time the design of steam and electrical machinery has reached almost its logical limit of efficiency and size. The next advance, he declared, will be the obtaining of energy directly from the sun with the aid of a low-pressure turbine. While a pound of steam at 200 lb. pressure contains 265,000 foot-pounds of energy, the same quantity at atmospheric pressure represents an energy content of 132,000 foot-pounds—about half that of the high-pressure steam. On this rather surprising fact is based the operation of the sun-power turbine, which receives its low-pressure steam from glass-covered courts containing pipes warmed by the sun's radiation. A plant of this kind recently completed in Philadelphia and shipped to the Sahara Desert, where it is to be operated, said Dr. Berg, actually developed 10,000 kw from an area 500 ft. square in the latitude of Philadelphia. Professor Berg then launched into a terse review of recent theoretical progress in electricity, outlining the experiments and phenomena which have led to the formulation of the electronic theory and the modern conceptions of the ultimate identity of electricity and matter. In this connection he gave some interesting estimates of the dimensions and magnitudes of the quantities involved, expressed in practical units.

ILLUMINATION.

Mr. A. J. Cole, of the Westinghouse Electric & Manufacturing Company, Chicago, followed with a paper on "The Wire-Type Tungsten Lamp," preceded by a clear description of the source and manufacture of the tungsten filament and data on its strength when new and after several hours' use, etc., obtained from a personal study. The wire-type lamp was also described in detail, and analyses were made of the cost of operating lamps of various specific consumption at different scales of energy cost.

"Modern Street-Lighting Systems" was the subject of the next paper, prepared by Mr. Warren Partridge, of Springfield, Ill., presenting a very complete enumeration of the various forms of arc and incandescent units now obtainable for street lighting. Mr. Partridge discussed the subject of ornamental post lighting from the standpoint of appearance, efficiency, contracts with customers, charges for service, arrangement of lamps, etc.

Mr. R. S. Wallace, of Peoria, observed that where possible contracts should be made on a candle-power basis rather than the watt basis, in order that the company may benefit from such improvements in illuminants as may occur from time to time, the city at the same time profiting when new contracts are to be let.

SINGLE-PHASE MOTOR.

Thursday morning's session was opened by Mr. F. N. Jewett, of the Wagner Electric Manufacturing Company, St. Louis, Mo., with a paper on the interesting new unity-power-factor single-phase motor recently brought out by this company and described in preceding issues of the *Electrical World*. The construction of the double winding of the motor was clearly explained, and a number of curves were included, illustrating its performance under various conditions, together with the beneficial effect on useful generator output of a unity-power-factor load. Mr. Jewett's paper also referred briefly to the new adjustable-speed single-phase motor which is now being developed. At the close of the paper the author answered a number of questions regarding the use and operation of these motors, put by Messrs. C. W. Pen Dell, of Chicago; J. H. Delany, of Chicago; W. A. Thomas, of Pittsburgh; S. B. Cushing, of Chicago; A. C. Martin, of Rockford; J. G. Learned, of Chicago, and Warren Partridge, of Springfield.

ELECTRICITY IN COAL MINING.

Mr. W. A. Thomas, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., read an interesting paper on the subject of the use of electricity in coal mines. The advantages of such drive to the mine operator are reduced cost of operation and investment and improved reliability. Primary applications of motors in mines are those of cutting, hauling and hoisting the material from the mine, while secondary applications are producing draft, pumping, draining and lighting in the mines. The latter secondary services are often undertaken first and later followed by the primary uses. Electricity for mine use is increasing in popularity much faster than compressed-air drive, although motor-driven compressors can often be operated to advantage by central-station companies. Mechanical haulage greatly increases the output of any given mine. Electric locomotives are now almost entirely used for this purpose, 204 electrical out of a total of 210 mining locomotives being now employed in Illinois and handling 54 per cent of the output.

A recent advance in the art has been marked by the new alternating-current hoist motors now available. The author described various methods of reducing the peaks of hoisting demand on central-station lines by the use of storage batteries and motor-generator sets, rotary-converter motor-driven flywheel sets and flywheel equalizing sets. Figures were added for a typical mining installation where all operations are done by electricity, the consumption averaging from 2.1 to 4 kw-hours per ton of coal mined, although these values will be less where the pumping load does not represent so large a part of the energy consumed. Many mines, said Mr. Thomas, put off converting to electric drive on account of the lack of capital required, as well as the prejudice which still lingers among operators.

Mr. C. W. Pen Dell, of Chicago, told of the satisfactory use of 60-cycle, 100-kw converters supplying energy for fluctuating crane and hoist loads in Chicago. As an experiment, he said, he has paralleled two such machines, loaded them to 50 per cent of their rating and then slammed on and off an additional load of 125 per cent without caus-

ing any trouble in the operation of the converters. Not only does the rotary converter show an efficiency of 15 per cent higher than that of the motor-generator, but much difficulty is often experienced in obtaining repair parts for the high-voltage motors of the latter sets. Mr. J. J. Frey, of Hillsboro, told of the use of electricity in mines in his vicinity, where motors have been installed to extend the economical life of shafts already worked to their limit by hand methods. A 300-hp coal washer, said Mr. Frey, also forms an important portion of his load. These mining services are restricted to off-peak use.

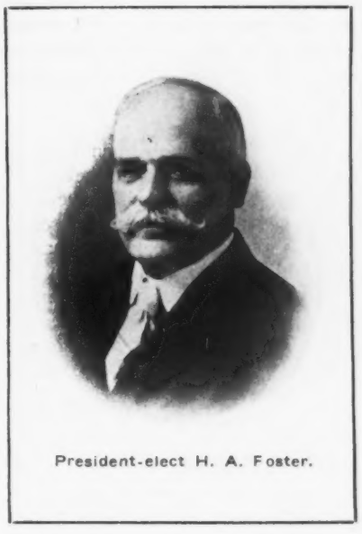
PUBLIC POLICY.

A note of growing interest to central-station men was struck in a paper on "Public Policy," by Mr. Charles T. Brown, of the H. L. Doherty Company, which was read by Mr. F. M. Sinsabaugh, of Mount Vernon. Many attacks on public-utility companies, observed the author, can be attributed rather to the lack of courteous explanations on the part of companies in transactions with customers than to dissatisfaction with high rates. Central-station men were advised to make friends with their customers, especially those who come into the office to register complaints. Competent employees are important to a public utility's success, and unremitting efforts should be made to increase the efficiency of even the ordinary men by coaching and encouraging them in the practice of their duties and in unfailing courtesy to the public. Efficiency, courage and ability now sell higher than ever before, wrote Mr. Brown, and the successful manager is he who does more than is required by his superiors, offers few excuses, guards against accidents and plans for the future. Such a man makes himself indispensable and invaluable in his position. The public unconsciously estimates the company by the personality of its manager, and if the latter is popular, honest and sincere the standing of the company benefits accordingly. Each customer's complaint should be carefully investigated and arbitrary decisions which may create enemies avoided. Usually the central station is one of the big interests in the community, and its manager should get close to the big men and point out to them that, although its own market is limited to the city, it wants local manufacturers to develop their production, so that in turn it and the community may prosper. The author urged the fullest publicity in the conduct of utility business, the central station taking the public into its confidence as the surest means of avoiding false criticism by enemies of its interests. The time is past, concluded the author, when companies can expect successfully to do a small volume of business at high rates.

Mr. J. H. Delany, of Chicago, pointed out that poor service acts as a fertilizer to the discontent of customers. The average consumer, he said, desires service and is willing to pay for it. Care must be taken not to misjudge the complaints of consumers, who sometimes have just grounds for objection. The good-will of the customer must be held at all events, and sometimes it is even advisable to "discharge" the same valued employee more than once to satisfy customers who feel themselves injured or aggrieved.

Mr. F. H. Golding, of Rockford, said that, while towns differ, human nature is practically the same throughout the country, and an open policy with public and officials will always be found the best course. Where a customer complains of a high bill and the Rockford company satisfies itself that this contention is honest, although finding no explanation for the increased meter reading, it stands willing to adjust the amount of the bill, impressing on the customer that this is done to retain his good-will. In no single instance, said Mr. Golding, has such a customer come back for a second adjustment. The same liberal policy is also maintained in the exchange of defective tungsten lamps. While the first cost per lamp may be slightly higher, the important result is obtained of keeping customers well satisfied. Mr. F. N. Jewett, of St. Louis, referred to the practice of a successful Eastern central station in keeping the newspapers its friends by furnishing them from time to time with news of its new equipment, plant additions, etc., taking care to impress on the public that its equipment is of the most up-to-date character and its service the most modern. Recently, when this company was embarrassed by the prospect of an ice jam in the water-power plant from which its supply is obtained the newspaper reporters were called in and the situation laid before them, with an account of the efforts being made to meet the emergency and the impaired service which might nevertheless be expected. An interesting story was thus worked up, and when the shut-down came, a couple of days later, the company had won the sympathy of the public and no complaints were registered.

Mr. J. G. Learned, of Chicago, said that the matter of public friendliness and sympathy is of the greatest value when franchises are needed or city lighting contracts are to be secured. In addition to supplying local newspapers with material for articles describing its plants the North Shore Electric Company purchases advertising to an amount equivalent to the monthly electric bills of the newspaper plants. The motto adopted by the North Shore company is "A square deal to the public," and employees are continuously urged both to talk and to live up to this maxim.



President-elect H. A. Foster.

"Motion Study in New Business" was the subject of the concluding paper, by Mr. E. W. Osborn, of the Rockford Electric Company. Taking a cue from the recent tendency in manufacturing operations to eliminate lost movements, Mr. Osborn pointed out the increase in efficacy which new-business solicitors will gain by systematizing and laying out their work so that no waste may result. "Being in the field at 9 o'clock and making every minute of that time up to 5 o'clock count will bring any salesman success," observed Mr. Osborn. Nor should the solicitor neglect the acquaintance of the customer after his contract has been obtained. Many odd minutes can be spent to advantage by pleasant calls to inquire whether the service is unsatisfactory. In this way many slight complaints will be smoothed out and little or fancied grievances avoided, which, if allowed to run on, might result in an ultimate loss of the business. Holding old business is as important a part of the solicitor's task as is the securing of new business. Meter record sheets might also be examined each month in advance of the regular mailing of bills to customers, and in cases of unusually heavy consumption ready explanations should be sought, for use when the customers' complaints are received.

ELECTION OF OFFICERS.

At its executive session, which followed the technical program of Thursday morning, the Illinois State Electrical Association elected officers as follows: Mr. H. A. Foster, Fairbury, president; Mr. J. J. Frey, Hillsboro, first vice-president; Mr. F. H. Golding, Rockford, second vice-president; Mr. E. Macdonald, Lincoln, third vice-president; Mr. F. W. Reimers, Rock Island, fourth vice-president; Mr. C. W. King, Lewiston, treasurer; Mr. H. E. Chubbuck, Peoria, secretary; Mr. C. A. Willoughby, Peoria, assistant secretary. The members of the executive committee for the same period are Messrs. W. B. McKinley, Champaign; F. J. Baker, Chicago; R. S. Wallace, Peoria; E. W. Smith, Kewanee; W. G. Austin, Effingham.

The committee on resolutions, composed of Messrs. R. C. Hardy, C. W. King and J. J. Frey, presented resolutions of respect regarding the death of Mr. W. J. Wetzel, of Eureka, in a plant accident last September. Thanks were also tendered to the technical and local press, the electrical supply men and the people of Rockford, and especially to the Rockford Electric Company and Mr. F. H. Golding, its manager, for the successful convention.

ENTERTAINMENT FEATURES.

During the convention at Rockford an electrical show was held in the local armory, the exhibitors being electrical manufacturers and several non-electrical local manufacturing companies. The building was tastefully decorated for the occasion and brilliantly lighted with the aid of many tungsten lamps.

On Tuesday evening the supply men tendered the convention delegates a smoker at the Hotel Nelson, accompanied by a Dutch lunch and vaudeville entertainment. Mr. W. R. Pinckard, of Chicago, introduced as toastmaster Mr. A. G. Brown, secretary of the Rockford Chamber of Commerce, and brief addresses in keeping with the gayety of the occasion were made by Mayor W. W. Bennett of Rockford; Mr. R. K. Welsh, attorney for the electric company; Mr. Cooper Wilkins, Mr. Fred Carpenter, of the Rockford Public Service Department; Mr. H. N. Remington, Mr. C. W. King and Mr. Fred Benson.

On Wednesday evening the association banquet was held, the convention being the guests of the Rockford Electric Company. Mr. F. H. Golding, manager of the company, introduced Mr. R. K. Welsh, its attorney, who acted as toastmaster and called upon Mayor W. W. Bennett; Capt. David Davis, of Litchfield, and Messrs. C. W. King, of Lewiston; W. G. Austin, of Effingham; J. H. Delany, of Chicago; C. W. Ferguson, of Rockford, and J. G. Learned, of Chicago.

Public Service Commission News.

MASSACHUSETTS COMMISSION.

A continued hearing on the subject of the demand indicator was held Oct. 27 by the Massachusetts Gas and Electric Light Commission. Mr. Junius Auerbach, representing some large consumers of electricity, said that the board should have authority to regulate these indicators and determine the actual amount of electricity used by a customer. He said he believed the principle of the indicator to be correct and that its removal would be an injustice to large consumers because by it a wholesale rate is given that class of customers, which could not be determined without its aid. He called attention to the fact that the Boston Chamber of Commerce, after considering the matter, had refused to indorse the proposition to do away with the indicators, and said there was no public demand for their abolition.

Mr. Joseph B. Eastman said that a consumer is entitled to know that any device upon which his charge for electricity is based is correct and is tested by public authority.

Mr. Everett W. Burdett, counsel for the Massachusetts Electric Lighting Association, said that his clients are anxious that the commission shall be given full power to test demand indicators and to require them to be kept at the proper standard. He said his clients were opposed to the proposition to prohibit their use. He said the purpose of the indicators is to enable the company to have accurate information about the electricity used. It has long been recognized that demand enters largely into cost, and that is the reason the indicator is employed. It is, said Mr. Burdett, a benefit to the consumer, for it enables him to get into a different class from that he otherwise would be in, with the effect of reducing his charges.

The Gloucester Electric Company has filed with the Massachusetts Gas and Electric Light Commission an appeal from an order of the Gloucester city government which granted authority to the Oceanside Company to run wires from its private lighting plant in its hotel in Gloucester to Magnolia, where it rents cottages in connection with its hotel. The route of the proposed line is on a public highway.

NEW HAMPSHIRE COMMISSION.

The New Hampshire Public Service Commission last week received a petition from the Keene Gas & Electric Company asking for permission to sell its lines and business in Ashuelot, N. H., to the Ashuelot company, and the latter company has petitioned the commissioners for authority to issue sufficient additional capital stock to take over the business.

WISCONSIN COMMISSION.

After a careful investigation into the present financial condition and the proposed extensions of the Apple River Power Company, the commission has approved the company's application for authority to issue $250,000 par value of 5 per cent bonds. The mortgage has been issued to the Illinois Trust & Savings Bank and William H. Henkle, as trustees. The proceeds to be derived from the sale of the bonds are to be used for paying an outstanding note of $125,000, for paying an outstanding indebtedness incurred by reason of additions made to the property and for making future extensions.

The Wausau Street Railway Company has been authorized to issue 1000 shares of common stock of par value $100 each, to be exchanged at par for a like amount of illegal stock now outstanding. It is specified that the total amount of legal stock outstanding shall in no event exceed $400,000. The stock to be called in was illegal because issued subsequent to the passage of the stock and bond law and without being authorized by the commission. The North Milwaukee Light & Power Company has been authorized to issue $12,040 par value of stock. The proceeds are to be used in paying off an outstanding mortgage indebtedness of $4,500, the proceeds from this source having been used for construction purposes and in paying an outstanding indebtedness of $7,500, incurred by reason of extensions and additions made to the property.

The commission has taken testimony on the application of the State Long Distance Telephone Company for authority to increase its rates. The company in its petition desired specially to increase the rate for business telephones from $2.50 to $3 per month, for the reason that the present total revenues are not sufficient to pay a reasonable return after providing for depreciation, and that, furthermore, the business telephones are not paying their proportionate share. Statistics of operation were introduced at the hearing to show that the number of business calls outnumbered all others, rural telephones included, in the ratio of three to one. For this reason the petitioners contended that the necessary increase in total revenues should come from an increase in the rates for business telephones

alone. The commission has taken the case under consideration.

NEW YORK COMMISSION.

The Public Service Commission for the Second District has ordered all operating electrical corporations within its jurisdiction to file information as to the electric meters which measure their output of electric energy. The information includes an estimate of the connected load of each company in kilowatts and of the total generating capacity of the various plants. The purpose of this order is to ascertain how completely the electrical companies are equipped with respect to instruments for measuring their output. These meters correspond to the large station meters which form an important part of a gas company's equipment.

The commission will hold a hearing at Mineola this week on the complaint of patrons of the Nassau Light & Power Company as to the rates charged for electricity for lighting purposes.

The second hearing on the petition filed by stationary engineers against the motor rates of the New York Edison Company, scheduled for Nov. 1, was postponed until Nov. 8.

MARYLAND COMMISSION.

The Maryland Public Service Commission has been requested by Mr. Charles England, chairman of the traffic committee of the Chamber of Commerce, to postpone the hearing on the telephone rates for one week. The request was granted. Mr. England stated that the members of the Chamber of Commerce are anxious to submit dates and evidence to the commission which cannot be collected before that time. Chairman Ambler said that he had conferred with the officials of the company, and that they were pleased to have the case postponed.

The function of the commission with respect to the protection of corporations from those whom the corporations deem unfair in business relations was appealed to for the first time last week, when the commission received a petition from the Consolidated Gas, Electric Light & Power Company, asking for a decision as to whether compliance with the demands of a customer for a special rate would be discrimination as against the other patrons of the company. It is set forth in the petition that the company made a contract with the Paper Mills Company to supply gas and electricity for illumination and power purposes at the regular rates, and that up to Feb. 16, 1911, the contract was satisfactorily maintained by both parties. Since that date the bills have not been regularly paid, says the company, and to the date of Sept. 23, 1911, they total $1,174.97, upon which partial payments to the amount of $517.04 have been made. The Paper Mills Company, so the petition states, has advised the Gas & Electric Company that it will not pay more than $100 per month for the service contracted for, and the Gas & Electric Company craves a ruling as to its right to comply with this demand without discriminating against other users of its product. The company asks the commission to decide whether a continuation of service to the Paper Mills Company under the conditions stated would be in accordance with the provisions of the public-utilities law or would amount to a violation of that law. Considerable speculation has been caused as to the reason for the petition.

The commission has been requested by the Maryland and Citizens' Telephone companies to act as arbitrator in a dispute which has arisen between them. Until July 28 last the two companies had an agreement by which the Citizens' company strung its wires on the cross-arms of the poles of the Maryland company on the Frederick Road. The Maryland company now asks the Citizens' company to remove its wires, alleging that the wires are in bad condition. This the Citizens' company denies, and has not complied with the request and will not remove the wires until the Public Service Commission has gone into the matter and reached a decision.

OHIO COMMISSION.

Many complaints have been made by men interested in Ohio public-utility corporations in regard to the position taken by the Public Service Commission on stock bonuses and excessive capitalization. Several decisions rendered within the past few days indicate that the commission will not grant authority to increase the issue of securities where the value of the property is already covered and the capitalization is in excess of its worth. In some cases it has been found that the physical value of properties is fully covered by bonds, while the stocks represent the earning power or the value of franchises upon which the earning power is based. Members of the commission state that this stand may retard the development of public utilities for a year or two, but finally the knowledge that securities are to be sold for a definite purpose will inspire confidence in the investors and public alike that will be valuable to the corporations.

The Men's Club of Rubicon, a social organization of Dayton, has requested the commission to make an investigation of the methods used by the Dayton Power & Light Company. It is claimed that the company is operating without a franchise from the city and that it is charging a minimum rate of 90 cents a month, which is claimed to be a violation of the laws. The petition asks if the company can operate without a grant from the city.

CURRENT NEWS AND NOTES.

WIRELESS AT "MASS. TECH."—A wireless station is being fitted up at the Massachusetts Institute of Technology by the Wireless Society of that school. A 10-kw transformer, property of the engineering department, will be a part of a powerful sending station, by which the young engineers will be able to communicate with many other Eastern colleges as well as regular stations. Prof. Harold Pender, of the department of electrical engineering, is aiding the society in the design of the station.

* * *

RESUSCITATION FROM ELECTRIC SHOCK.—The United States Bureau of Mines, Washington, has issued a circular (Miners' Circular No. 5) entitled "Electrical Accidents in Mines: Their Causes and Prevention." One section contains rules, with illustrations, for resuscitation from electric shock, the Sylvester method of artificial respiration being specified. According to this older method the patient is placed face upward. In many recent rules the newer Schaefer, or prone, method is employed, in which the patient is placed face downward.

* * *

PUBLIC RELATIONS OF UTILITY COMPANIES.—Mr. H. O. Seymour, general agent for public relations of the Chicago Telephone Company and formerly general manager of the Wisconsin Telephone Company, addressed the Electric Club of Chicago on Oct. 25 on "Corporate Public Relations." The subject of "excessive return" on investment was touched upon, and Mr. Seymour pointed out that the early investors were pioneers and entitled to credit and remuneration for their courage and perspicacity. Mr. K. B. Miller spoke of the Los Angeles situation, and said that at one time in that city the pendulum swung too far from the median line of strict justice to the corporations. It is now coming back, however, and after some oscillations a pretty fair balance will be struck undoubtedly. The rate question is very complex, for the indirect costs and charges are hard to determine. Messrs. George B. Foster, Commonwealth Edison Company; W. R. Abbott, Chicago Telephone Company; H. E. Niesz and J. H. Delany, Cosmopolitan Electric Company, took part in the discussion also.

The Silver King Mining Company.—The Silver King Mining Company, of Marion County, Oregon, is considering the establishment of an electric smelter, the first of its kind in the State.

* * *

Slogan Sign for Warren, Ohio.—A committee of business men of Warren, Ohio, is extending invitations for suggestions for a motto to be placed on a huge civic electric sign to be erected at that place. Warren is described as the electrical center of the Central States, famous for diversified manufacture, superb in beauty and as a place to work, invest or live in. Suggestions should be sent to the postmaster.

* * *

Scranton Company Section, N. E. L. A.—The first meeting of the season of the Scranton Company Section of the N. E. L. A. was held in the Board of Trade Building Oct. 26. Three papers were presented as follows: "Operating Costs," by Mr. L. B. Webster; "Special Station Construction Problems," by Mr. J. B. Pigott, and "Co-operation and New Business," by Mr. T. C. Walsh. The section has now over fifty members.

* * *

Electricity Versus Compressed Air.—In a paper recently presented before the American Institute of Mining Engineers Mr. K. A. Pauly gave figures showing the advantages of electric motors over compressed-air engines in mining operations. In one case the estimated first cost of plant for a given service is $54,500 for air and $53,800 for electricity, while the operating costs per annum are $35,365 and $25,168 respectively. In another case the first cost for air is $512,000 and for electricity $520,600, the respective annual operating costs being $322,670 and $232,542.

* * *

N. E. L. A. Section Meeting in Pittsburgh.—The Allegheny County Light Company Section of the National Electric Light Association held a meeting in connection with a banquet at the Hotel Rittenhouse, Pittsburgh, on Oct. 30. The speakers included Mr. W. A. Donkin, secretary of the Pittsburgh Industrial Commission; Mr. R. S. Orr, general superintendent of the Allegheny County Light Company and president of the Pennsylvania Electric Association, and Mr. Robert L. Jaynes, Jupiter of the Sons of Jove. The keynote of the meeting was harmony of electrical interests in boosting Pittsburgh.

* * *

Electricity in Pound Lots.—In discussing the electron theory and modern scientific conceptions of the ultimate identity of electricity and matter before the Illinois Electrical Association at Rockford on Oct. 23 Dr. E. J. Berg, of the University of Illinois, gave some striking comparisons of the magnitudes of these ultimate particles in terms of practical units. At schedule rates for electricity in Chicago he estimated roughly a pound of electrons would be worth about $6,000 and the system of the Commonwealth Edison Company would be capable of producing about a pound each hour. Such a pound of electrons would keep a 50-cp lamp in service for 5000 years.

* * *

Cleveland Section A. I. E. E. Meeting.—"Industrial Lighting," by Mr. C. L. Eschleman, of the Adams-Bagnall Electric Company, and "The Choice of an Illuminant," by Mr. I. H. Van Horn, of the National Electric Lamp Association, were the titles of two papers read at a meeting of the Cleveland Section of the American Institute of Electrical Engineers held on Oct. 23. Mr. Eschleman cited statistics and personal experiences tending to prove the sacrifice of output and quality and the greater percentage of accidents in poorly lighted factories and the relatively low cost of good illumination when compared with the value of its benefits. Mr. Van Horn gave a detailed analysis of the qualifications which an illuminant should possess, and reported the results of some recent tests to determine the critical frequency of visible flicker for various kinds of incandescent lamps. Both papers were illustrated by the stereopticon.

* * *

Hydroelectric Municipal Plant at Sudbury Reservoir.—In addition to the hydroelectric station now being operated by the State of Massachusetts, through its Metropolitan Water and Sewerage Board, at the Wachuset dam at Clinton, a description of which appeared in a recent number of the *Electrical World,* there is probably soon to be installed a second generating plant, to be located at the dam of the Sudbury reservoir. The fall at the Sudbury dam, though less than that at Clinton, is yet sufficient to give it value for commercial purposes, and its possibilities have been examined by Mr. Dexter Brackett, chief engineer of the Water and Sewerage Board, which has authority to build a station at this point.

* * *

Tentative Subway Plans for Chicago.—The Subway Commission of Chicago on Oct. 31 presented tentative plans to the local transportation committee of the City Council. Two initial subways are recommended to be connected with the four elevated railways of the city and to furnish through routes for rapid transit through the heart of the city. There may be also two initial surface-railway subways connecting the three sides of the city. The commission recommends as the initial step the building of a system to connect the elevated railways. This plan contemplates high-level subways, through routing, no grade crossings, few curves, low cost, and provides for unlimited expansion. The length of the elevated-railway subways would be 3.85 miles.

* * *

Peoria's Flashlight Police-Call System.—In Peoria, Ill., the Gamewell Fire Alarm Telegraph Company has installed what is said to be the largest light-signaling police-call system in the country. On the police-patrol signal boxes scattered about the streets are placed red incandescent lamps. When it is desired to communicate with patrolmen on the street from police headquarters these lamps, or a certain number of them, are put in circuit and they at once attract the attention of the policemen on the various beats, who proceed to the signal boxes and get the necessary instructions by telephone. By this means if, for instance, a burglary is reported the patrolmen on nearby beats can be notified in a very few minutes. A number of parties of city officials from other cities have inspected this flashlight police-call system in Peoria.

* * *

Increase in Taxes on Ohio Telephone Companies.—Telephone managers in Ohio view the work of the State Tax Commission so far with anything but satisfaction. The commission has fixed tentative valuations upon a few of the large properties, and they show immense increases from the figures used last year. Telephone properties of the State were fixed by the commission last year at $21,000,000. It is believed that the figures for 1910 will reach $55,000,000. A few of the tentative increases follow: Cleveland Telephone Company, from $2,037,702 to $6,500,000; Cincinnati & Suburban Telephone Company, from $2,722,330 to $10,000,000; Central Union Telephone Company (including all Bell property in the State outside of Cleveland and Cincinnati), from $4,903,698 to $13,000,000; Cuyahoga Telephone Company, Cleveland, from $1,296,161 to $4,500,000; Akron People's Telephone Company, Akron, from $234,780 to $450,000. Increases in the valuation of telegraph properties in the State are as follows: Postal, from $397,550 to $796,500; Western Union, from $2,335,375 to $4,045,680; Put-in Bay Telegraph Company, from $1,800 to $5,000.

ILLINOIS MUNICIPAL POLE-LINE TAX.—A decision in a case brought by the city of Springfield, Ill., against the Postal Telegraph Cable Company confirmed the contention of the former that cities can levy a reasonable tax for the use of streets by telegraph poles.

* * *

ELECTRICITY FOR OSSIAN, IND.—The village of Ossian, Ind., has granted an electric-light franchise to the milling firm of Reidel & Gray, who are empowered to place poles and wires in the streets and alleys of the town. The distributors will buy electrical energy from the Ft. Wayne & Northern Indiana Traction Company, of Ft. Wayne, Ind.

* * *

MOUSE SHUTS OFF ELECTRIC LIGHT.—The town of Crookston, Minn, was recently thrown into darkness by a mouse, which was electrocuted by crawling between the points of the main switch, its charred body short-circuiting the line. A panic was narrowly averted in a public building where there was a children's show, and many citizens assumed that bank robbers who had shortly before visited a neighboring town were responsible for the sudden darkness.

* * *

ELECTRICAL MEN INSPECT BRIDGE.—Members of the St. Louis League of Electrical Interests inspected on Oct. 28 the Municipal Free Bridge now being erected across the Mississippi River. The inspection was made as the result of an invitation from Mr. O. B. Barrows, of the American Steel & Wire Company. Following it, at the noonday luncheon of Oct. 31, Mr. Edward B. Fay, of Brenneke & Fay, bridge engineers, addressed the league on "Construction Details of the Municipal Free Bridge."

* * *

DANGER OF RÖNTGEN RAYS.—Mr. Thurman L. Wagner, of St. Louis, is one of the Röntgen-ray experimenters who have suffered by reason of devotion to the useful applications of Röntgen's great discovery. For eight years Mr. Wagner has suffered from X-ray burns which have affected both hands, and recently his left hand was amputated in order to save his life. It is hoped that the injuries to the right hand are not serious. The number of physicians and inventors who have been seriously injured, or who have even lost their lives, in perfecting Röntgen-ray apparatus has reached considerable proportions.

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THE PEAK LOAD OF A BASEBALL CROWD.—Many businesses have long had their peak loads, load factors, diversity factors, etc., but it seems that not until electrical men applied their engineering instincts to the problems of electricity supply have these quantities been recognized, named and given their due consideration. The latest unusual application of the demand printing attachment of a well-known electrical meter was at a recent Chicago baseball game where the rate of passage of the crowd through the gates was recorded with a view to determining the time of peak load so that in future better provisions might be made for handling the throngs.

* * *

QUINCY, ILL., ADVERTISES ITS WATER-POWER POSSIBILITIES.—The business men of Quincy, Ill., which city is about 35 miles south of Keokuk, Ia., where the great Mississippi River hydroelectric dam is in process of erection, are alive to their opportunities. They are advertising extensively to point out that Quincy is adjacent to the great dam and that it will be in the zone of lowest cost for the power when available. The attention of manufacturers is called to the possibilities of this zone, which the Quincy people say is destined to become the industrial center of the United States. The business men of Keokuk, Ia., and Burlington, Ia., are also bestirring themselves to take advantage of the cheap electrical power which will be available on the completion of the Keokuk dam.

PROPOSED PANAMA TRIP OF THE INSTITUTE.—It is proposed that a trip of inspection to the Panama Canal be undertaken by the American Institute of Electrical Engineers, with sailings from New York and New Orleans between Jan. 20 and 30, 1912. Each boat can accommodate eighty-eight passengers, making the total number 176. The round-trip price per passenger is $125 from New York and $95 from New Orleans. These rates do not include hotel accommodations on the Isthmus, which, at the Tivoli, are $5 to $6 a day, American plan. The round trip from New York requires twenty-one days and from New Orleans about seventeen days. This allows seven days on the Canal Zone. However, if desired, only one and one-half days need be spent on the Isthmus, the remainder of the week being taken up by an extension trip to Santa Maria without extra charge. Prompt action will be necessary to secure reservations, as the trip will be a popular one undoubtedly. Mr. S. D. Sprong, of New York, is chairman of the committee.

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ILLINOIS LEGISLATURE FAILS TO PASS DEEP WATERWAY BILL.—Governor Deneen's deep waterway bill was defeated on Oct. 25 at a special session of the Illinois Legislature. In a statement issued by the government after the defeat of his bill he says that he has endeavored during his term of office to place the State in a position where it could utilize the water-power to be created in the Des Plaines and Illinois Rivers by a deep waterway between Lockport and Utica, Ill. His idea is to pay off the bonds issued for the construction of the work by the revenue received from the water-power. The Governor declares that the corporations which are interested in the utilization of the water-power of the Des Plaines and Illinois Rivers are aggressive and vigilant; but he contends that the water-power rights created entirely through the expenditure of public money will be worth $2,500,000 a year and should be retained under public control. Companies which utilize water-power on the Des Plaines and Illinois Rivers, and to which the Governor seems to refer, are the Economy Light & Power Company, of Joliet; the Illinois Valley Gas & Electric Company, with headquarters at Streator, and the Marseilles Land & Water Power Company, of Marseilles.

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COPENHAGEN PEAK-LOAD TELEPHONE AUXILIARY.—In Copenhagen, Denmark, which has 550,000 inhabitants, there are about 40,000 telephones in service. The rapid growth of the system has necessitated careful study of telephone traffic and resulted in several interesting devices for economy of time and labor. Among these is an automatic equipment, invented by Director Fr. Johannsen, of the Copenhagen Telephone Company, for transferring an incoming call to an idle operator in case the called operator is busy. At each operator's position three of the answering cords are connected with automatic selectors, and thereby changed into "transfer cords." When any operator uses such a cord in attending to a call she transfers the call to a disengaged colleague, the automatic device of the selector moving along until it reaches a wire from a disengaged operator within the same group of twenty operators to which the first operator belongs. The disengaged operator answers the call at once, even if she is obliged to transfer one of her own calls in order to do so. In one of the Copenhagen stations it was found that 220 jacks could be handled at each position with the peak-load auxiliary apparatus in service just as expeditiously as 160 jacks could be handled with the purely manual equipment. The automatic selector employed in Copenhagen is of the electro-pneumatic type, the motive power being supplied by air compressed to one atmosphere of pressure. The speed of movement is such that all twenty contacts are "searched" in 0.6 second. In case all contacts are engaged at one time the selector travels back and forth until it finds a disengaged contact.

Faraday Portrait.—Miss Jane Bernard, who had been amanuensis to her uncle, Michael Faraday, died in England recently. By her will she bequeathed Butler's portrait of Faraday to the English nation.

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Los Angeles Electrical Exposition.—The Los Angeles Electrical Exposition will be held in Fiesta Park from Nov. 25 to Dec. 9. An effort is making to provide a large and fine display of electrical apparatus and novelties.

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Louisville Central-Station Steam Heating.—It has been announced that the Louisville (Ky.) Lighting Company intends to enter a strong bid for the franchise to erect and maintain a public-service heating plant which the General Council will offer for sale in a short time.

* * *

Enameled Copper Wire Used for Surgical Sutures.—A company manufacturing enamel-insulated wire for electrical purposes has found an unexpected application of its product for surgical work. On the purest copper wire of No. 30 gage a coating of enamel is baked in the usual way, making an excellent thread for suture work.

* * *

Sun-Power Plant for Sahara Desert.—A large "sun-power" plant was recently completed in Philadelphia and shipped, it is stated, to the Sahara Desert. It employs a glass-covered court 500 ft. square containing heating pipes, the steam from which is led to a low-pressure steam turbine. It is claimed that on test in Philadelphia the arrangement developed an enormous capacity in horse-power, which will be more than doubled on the "burning sands" of the desert.

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Electrical Students at Kentucky State College.—Twenty-one seniors, twenty-three juniors, thirty-five sophomores and eighty-seven freshmen are this year registered in the combined course of electrical and mechanical engineering at the Kentucky State College, Lexington. The aim of this institution is to develop men familiar with both the steam and electrical ends of power plants, and work in surveying and business contracts is also included in the "dynamic engineering" course above alluded to. Prof. F. Paul Anderson is director of the engineering schools, and Prof. W. E. Freeman is in charge of electrical engineering.

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Dummy Meters.—At a recent electrical gathering in Chicago one of the gentlemen present told a story about an experience he had had in Boston some years ago while selling meters. One day a typical New England Yankee from a small town came in and said he wanted twenty-five watt-hour meters. A price of $11.50 each was quoted, but the visitor said that he did not want to pay more than $3 each and that he wanted only the outside case and the dial, the interior mechanism being superfluous. In answer to a further question the caller said that he furnished electric light in his town at a flat rate, but he wanted to put the dummy meters in because of their moral effect in preventing his customers from burning their lamps all night long.

* * *

The Copper Industry.—At the recent American Mining Congress held in Chicago Mr. Horace J. Stevens, of Houghton, Mich., read a paper on "The Copper Industry," in which he made the interesting statement that the copper produced in the decade ended Dec. 31, 1910, was the equivalent of more than three-fourths of the entire production for the preceding century. The demands of the electrical industries are very largely responsible for this remarkable increase in the demand for copper. The great bulk of the world's copper is now refined by electrolysis and it is of further interest to note that the number of copper mines using electrical energy in the work of producing copper has largely increased during the last decade. There is now a surplus of about 300,000,000 lb. of copper on hand, but in view of the enormous rate of consumption this is not a particularly serious matter. Mr. Stevens concluded his paper by a bitter arraignment of the United States government for its policy in relation to the conservation of natural resources, particularly mineral lands.

* * *

Prime Movers Committee of N. E. L. A.—The first meeting of the 1911-1912 committee on prime movers of the National Electric Light Association was held in Chicago on Oct. 24. All the members of the committee were present, including Mr. I. E. Moultrop, of Boston, chairman; Messrs. W. L. Abbott, of Chicago; John Hunter, of St. Louis; R. S. Kelsch, of Montreal; J. B. Klumpp, of Philadelphia, and W. N. Ryerson, of Duluth. The committee will report at the Seattle convention of the association next year on gas, water-power and steam prime movers, paying particular attention to hydroelectric development. The work to be undertaken was outlined and Messrs. Ryerson and Kelsch were appointed a sub-committee on water-power, Messrs. Hunter and Abbott on steam-turbine, boiler and furnace work, and Mr. Klumpp on gas prime movers with especial reference to an investigation of the Humphreys pump. The next meeting will be held in New York, it is expected, and probably at the time of the December meeting of the American Society of Mechanical Engineers.

* * *

Colorado Electric Club.—At the midweek lunch of the Colorado Electric Club on Oct. 18 the guests included the senior class of the University of Colorado, the Jovians attending the Denver national rejuvenation, Mr. Dana Pierce, electrical engineer of the Underwriters' Laboratories, Chicago, and Colonel Collier, of San Diego, in charge of the 1915 all-year exposition in that city. Over 200 were present. Talks were given by Colonel Collier and by Judge Milliken, of Denver, asking for a national co-operation to boost travel to the West during 1915, and by Mr. Dana Pierce, commending the growing co-operation between manufacturer and underwriters in the development of standards to the betterment of practice. Mr. Jaynes, tenth Jupiter; Mr. H. Harris, of the Pittsburgh Industrial Commission; Professor Evans, of Colorado University; President Carstarphen, of the Electric Club, and Mr. Cudmore, of Cleveland, all spoke briefly, each for his own interest, but with co-operation as a keynote. The electric show was attended by the entire assembly at the close of the luncheon.

* * *

Electrical Journals as a Technical School's Textbooks.—Once each week the senior engineering students in the Kentucky State College at Lexington meet to review articles in the current engineering press. Every second week the electrical journals are gone over, after having previously been assigned, one publication or one issue to each member of the class. When called upon the students review briefly the principal new or interesting subjects contained in their respective papers and show considerable enthusiasm and interest in finding unusual or specially valuable subject matter. The benefit of this practice is, of course, manifold, each member of the class profiting from the careful perusal which one of their number has given each of the various issues. When interesting subjects are uncovered others of the class can later refer to these articles for their own leisurely reading. Another great value of the method lies, too, in the practical and up-to-date ideas of electrical machinery and affairs which the students gain from such current electrical literature, along with the use of their textbooks.

CINCINNATI'S PLUM STREET STATION.

Conversion of a Reciprocating Steam Plant to Modern Turbine Equipment.

Natural-Gas Boiler Equipment.—Details of Switchboard Signaling.—Street-Lighting Equipment of 128 Seventy-five-Lamp Mercury-Arc Rectifiers.

THE recent history of steam-power progress is virtually recorded in the equipment of the Cincinnati Union Gas & Electric Company's Plum Street station, a plant which has spanned the periods of reciprocating-engine rope drive and direct connection, and finally high-speed turbine-generator equipment. The lesson, too, of the rapid obsolescence of electrical machinery is nowhere better exemplified than in the street-lighting service performed by this station, first with rope-driven direct-current arc machines, then with series alternating-current arcs supplied through constant-current transformers, and in the near future with direct-current magnetite arcs through rectifier sets. The recent contract for 6000 such high-efficiency arcs and 128 seventy-five lamp rectifier sets for Cincinnati is the largest order ever placed for similar equipment.

The Cincinnati central station is also notable for several of its huge reciprocating-engine-driven machines. It contains the largest 60-cycle engine-driven alternator ever built, the largest 300-volt direct-current generator and the largest double-generator, 125-volt Edison three-wire set. And of grim interest it is, too, to note that the two steam turbines now operating at Plum Street, although occupying hardly one-sixth the total engine-room space, have a combined capacity 15 per cent greater than all of the reciprocating equipment.

ARRANGEMENT OF PLANT.

The arrangement of engine and boiler-rooms in the Cincinnati plant, as a result of its successive additions, probably has no counterpart among other steam stations of the country. The two boiler-rooms make up roughly a large T, the old boilers forming the shank of the letter and the new room the transept. Completing the 166-ft. by 342-ft. rectangle of the outside walls, under the right arm is the original engine-room, 60 ft. by 251 ft., and at the left is the new addition, equivalent in size, and containing the turbines and the three very large reciprocating engines. While this layout to a certain extent groups the older boilers and steam units within short header distances, it unfortunately cuts up the engine-room, separating the controlling switchboard from the principal portion of the generating machinery.

The original Plum Street plant was completed in 1898, while the last new addition was finished in 1902. As above outlined, the general outside dimensions of the station are in the form of a large rectangle, 166 ft. wide and 342 ft., a city block, long. During these series of changes, however, the plant has been kept thoroughly modern, being brought down to date as successive units were added. It contains, for example, such modern refinements as remote-controlled oil switches for all alternating-current machinery, motor-operated valves on all steam and exhaust lines, visible signaling circuits, curve-drawing instruments, special meters and regulators on the switchboard, etc.

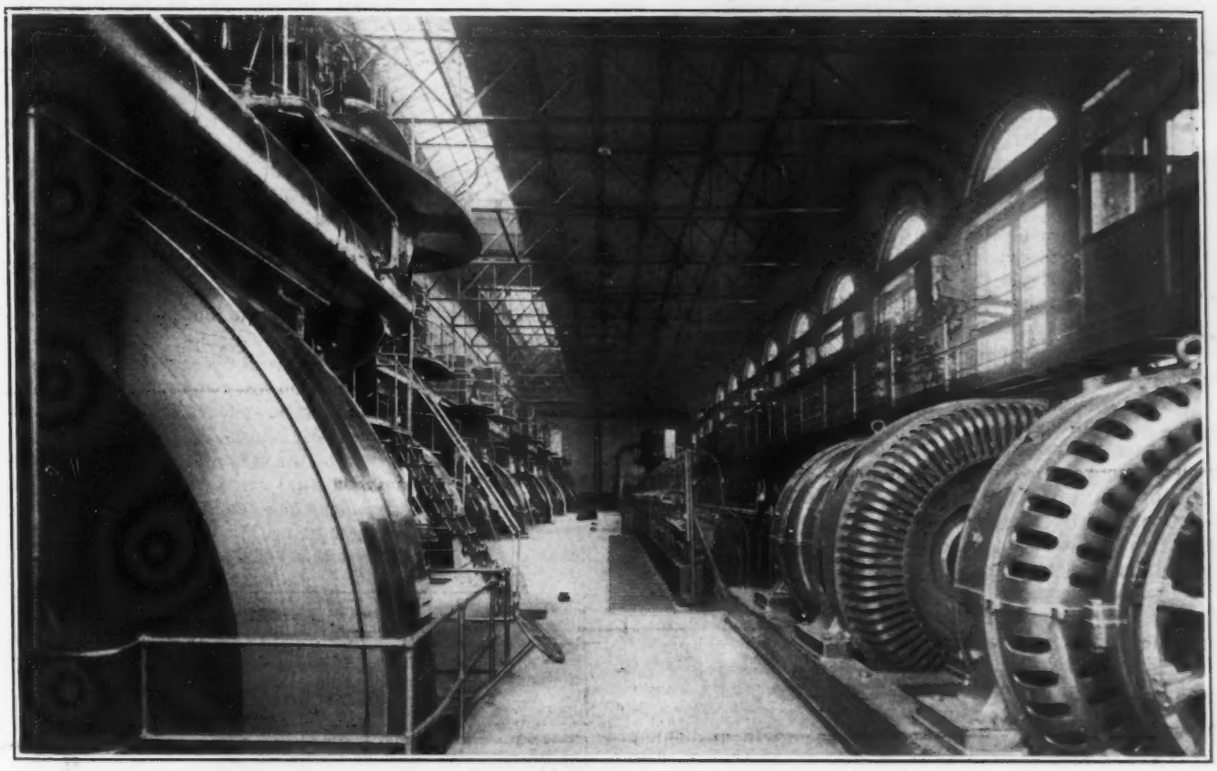


Fig. 1—Interior of Older Engine-Room, Showing Switchboard, Motor-Generator Sets, Etc.

BOILER-ROOM EQUIPMENT.

Natural gas from the West Virginia fields is ordinarily used as fuel, although all of the boilers are arranged with coal chutes from the overhead bunkers and with automatic stokers, so that the latter fuel is always available for emergency use. During the winter peak loads, however, a group of eight of the boilers in the new section is fired with coal exclusively.

The old boiler-room, measuring 251 ft. by 46 ft., contains in one row six 525-hp Babcock & Wilcox, six 525-hp Edge Moor and two Stirling boilers, all equipped with American underfeed stokers, with the exception of one of the Stirling units, an 825-hp boiler, which is fired by a Jones underfeed

stoker. The new boiler-room, 91 ft. by 166 ft., contains sixteen 542-hp Stirling boilers, eight of which are equipped with Jones stokers for coal burning exclusively and eight with gas burners and American stokers, all of the forced-draft underfeed type. The speed of operation of the Jones stokers and draft fans is automatically controlled from the steam-header pressure.

These average twenty-one gas burners to each gas-

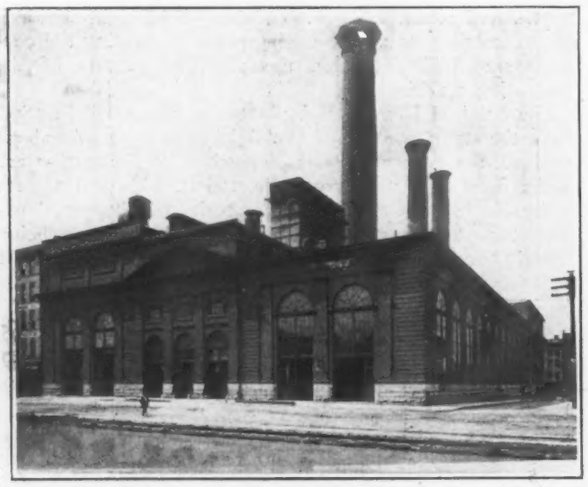


Fig. 2—Plum Street Station, Cincinnati, Showing Discarded Cooling-Tower Arrangement, and Canal Source of Water Supply.

equipped boiler, the gas being delivered to the furnaces in the older room through a 20-in. main extending the length of the boiler fronts. From this main 9-in. lines are branched off to each pair of furnaces. The gas burners used are of home-made design, comprising simply 1-in. pipes thrust through 6-in. openings for admitting the secondary air. Gas is delivered to the burners at 8 oz. per square inch pressure and is regulated by hand. The only alteration required in the coal grates for gas burning is the provision of a tile covering over the bars.

Coal is delivered to the plant by wagons, and is hoisted by two McCaslin and one Jeffries conveyors to the overhead bunkers, where it is distributed above the boilers, ready for emergency use. A reserve of 4000 tons is at all times held in the bunkers in this way.

The boilers maintain a steam pressure of 160 lb. per square inch. No superheaters are installed. The group of six Edge Moor boilers is equipped with a Greene economizer for raising the temperature of the feed water. The plant is provided with three large stacks, one 22 ft. in diameter and 204 ft. high and two 17 ft. in diameter and 201 ft. high.

Feed water for the boilers is taken from the canal which passes along Plum Street in front of the station. This canal is fed from the Miami River, 35 miles distant, and its water, although of unpromising appearance, is well suited for boiler purposes. Several paper mills are in operation a few miles above Cincinnati, and one explanation offered is that some of the waste matter from these mills discharged into the canal acts as a softener, adapting the water for boiler-feed use.

OLD ENGINE-ROOM.

The older engine-room contains seven vertical cross-compound Allis engine-driven sets, ranging from 900 kw to 1500 kw in rating. Here also are the motor-generator and exciter sets, arc-lamp equipment, switchboard gallery, etc. Several of these engine sets drive both a direct-current generator and an alternator on the same shaft, the alternating-current units averaging 500 kw and the direct-current machines ranging from 1000 kw to 450 kw. Two others of the sets drive pairs of 125-volt, three-wire generators, one pair with disk-type commutators. The foregoing engine-driven equipment is of General Electric and Bullock manufacture.

With the exception of unit No. 1, the 1500-kw, 300-volt direct-current machine nearest the Plum Street front, all of these Allis engines operate at the comparatively high speed of 120 r.p.m. Four of the present engines were originally used for rope-driving the Brush arc machines once installed at Plum Street, the old grooves being still visible behind the screens that have been considerately erected for their concealment. The direct-connected machines set on to their shafts are of a later date. All of the engines in the old section exhaust into a pair of jet condensers, the steam-driven Bibus rotary vacuum pumps for which are in the boiler-room adjoining.

NOTABLE RECIPROCATING UNITS.

Among the varied large apparatus in the newer engine-room, principal historical interest surrounds the 3200-kw, 60-cycle, 4500-volt, three-phase Bullock alternator, driven by a 42-in. by 88-in. by 60-in. vertical cross-compound Allis-Chalmers engine at 75 r.p.m. This alternator, the only one of the so-called "Berlin" type in America, is also declared to be the largest 60-cycle engine-driven machine ever built. It was completed under the design of Mr. B. A. Behrend, then chief engineer of the manufacturing company at Cincinnati. The rotating flywheel field element is 31 ft. in diameter and weighs complete with its coils 190 tons.

Adjoining the large alternator set is a generally similar engine, driving the huge 2500-kw, 300-volt direct-current Bullock generator, itself a record breaker in the direct-current class and the largest 300-volt continuous-current generator ever built. The flywheel with which it is provided alone weighs 100 tons and runs at 75 r.p.m. The armature is 30 ft. in diameter and the commutator 16 ft. across.

The third noteworthy machine at Plum Street is the two-unit, three-wire set, made up of two 125-volt, 1250-kw direct-current General Electric generators driven by a vertical cross-compound McIntosh & Seymour engine. This outfit is declared to be the largest three-wire balancer set in existence, having a total rated capacity of 2500 kw.

All three of the very large engines in the new section are operated condensing, exhausting into a jet-type condenser, served by a steam-driven vacuum pump located in the

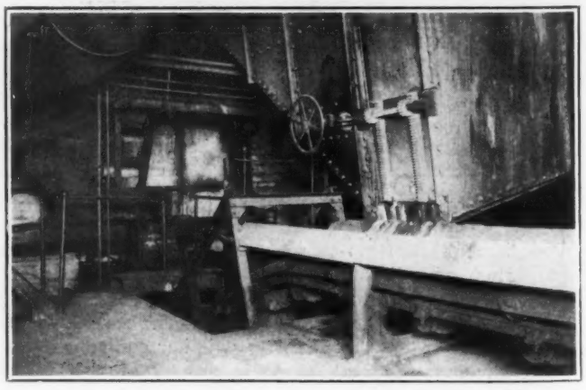


Fig. 3—Coal-Unloading Hopper (at Left) and Ash Hoppers, Discharging Into Conveyor.

engine-room. Condensing water for the station is obtained from Cincinnati's famous canal, locally known as "the Rhein," which passes in front of the power house. This stream, which has a sluggish current, gives ample cooling water for carrying the entire load condensing at any time of the year, all of the condensers with the exception of that on one of the turbines being of the jet type.

MODERN TURBINE-GENERATORS.

Several years ago, in 1907, the first turbine unit was

added to the Plum Street plant. This 5500-kw vertical Curtis turbine drives its 4500-volt, three-phase, 60-cycle alternator at 720 r.p.m., its exhaust being cared for by a Worthington base-type surface condenser. A 3-ft. free exhaust line is run to the top of the building. The circulating pumps, step-bearing pumps, accumulator, oil filter, air and circulating pumps, all engine-driven, are located on the basement level below the main floor.

The latest unit in the Cincinnati family is a nominal 7200-kw horizontal Westinghouse turbine-generator set, running at 1800 r.p.m. This turbine is of the double-flow type, securing the advantage of compactness due to this construction. It is equipped with a Leblanc jet-type condenser, freed of air and water by rotary turbine-driven pumps.

The free-exhaust line and air intake pipe are led directly from the roof as shown. While nominally rated at 7200 kw on a twenty-four-hour continuous basis, this newest turbine is capable of carrying without effort loads exceeding 10,000 kw, on the basis of the usual short-hour rating. The floor space allotted to the horizontal units is hardly one-half of that of the vertical turbines, including all auxiliary apparatus, space to withdraw condenser tubes, etc.—an interesting commentary on the relative space economics of horizontal and vertical units in practice.

For signaling between the switchboard operator and the tenders on duty at the turbines in the adjoining room, 200 ft. distant, pedestals are provided containing lettered glasses, "Stop," "Start," "Stand-by," "Load," "Asst. wanted" and "O.K.," behind each of which is a lamp in series with the corresponding lamp in its companion pedestal. These lamps are connected up with three-way switches, one of the pair at each station. To signal the attendant the switchboard operator pushes the button lighting, say, "Start" in both pedestals. As his own lamp is burning normally he knows the distant signal must also be alight. To acknowledge the signal the attendant pushes the corresponding button, extinguishing the lamps. By means of a relay in the pedestal alarm bells at both the adjacent and distant signals are kept ringing as long as any lamp is

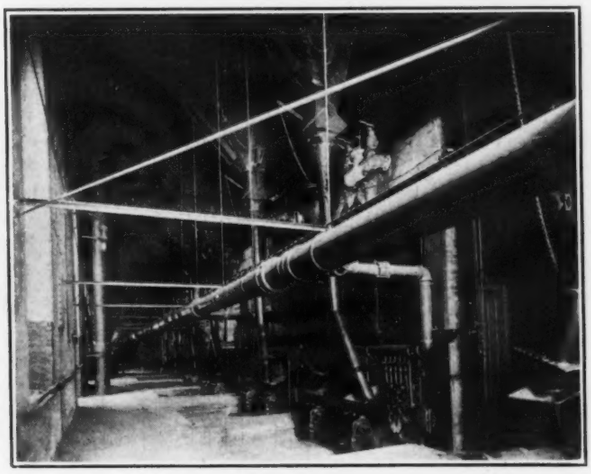


Fig. 4—Old Boiler-Room, Showing Arrangement for Gas and Underfeed Coal Firing.

burning. With this device the attendant can, of course, also originate signals back to the switchboard.

STEAM PIPING.

On all important steam headers, boiler lines, machine steam lines and exhausts motor-operated valves are provided, no less than fifty-four of these being in use in the station. The valves controlled range in size up to 50 in. and are operated by motors of from 1 hp to 3 hp. The controlling switches are located at emergency stations scattered through the plant, inclosed in glass-covered cases which can be forcibly entered when necessary. With the aid of these valves it is possible to control steam lines without approaching the site of trouble, a valuable precaution in an emergency. All steam headers are ranged at the basement level.

AUXILIARY ELECTRICAL APPARATUS.

Direct-current energy for excitation purposes is furnished by two 125-kw, 125-volt machines, one turbine driven and the other operated by a 4500-volt synchronous motor. On the floor of the older engine-room there is also located a 3000-kw, 220/110-volt direct-current substation, feeding into the downtown Edison network along with the steam-driven direct-current machines. It is the practice, however, to use the turbines only during the major portion of the day, reserving the engine-driven direct-current generators for auxiliary use during the peak period.

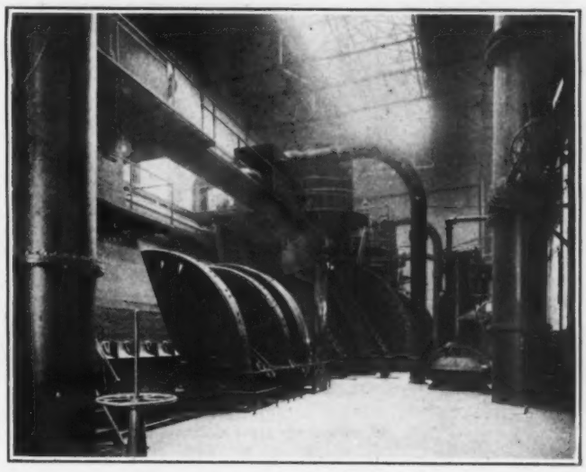


Fig. 5—Huge Reciprocating-Engine-Driven Units in New Engine-Room.

The accompanying reproduction of a typical winter load curve on the Cincinnati station shows the sharp and steep peaks experienced, due to the demands for lighting service. Another characteristic of the Cincinnati service, resulting from the city's location in the midst of steep river valleys, is the suddenness with which dark clouds may descend over the business section, causing a rapid increase in load from 10,000 kw, normal, to 30,000 kw for a short time. The 4500-volt motor-generator equipment at Plum Street comprises two 500-kw, 300-volt Bullock sets, one 1000-kw, 300-volt Westinghouse set, one 200-kw Bullock three-unit 300/150-volt set and one 1000-kw Westinghouse three-unit set.

SWITCHBOARD AND CONTROL.

Along the north side of the old engine-room is arranged the switchboard gallery, controlling both the direct-current and alternating-current systems. The 4500-volt alternating-current oil switches are all remote-controlled. The nine General Electric type E main feeder oil switches are in the new engine-room alongside the three similar machine switches (one of Westinghouse make) for the two turbo and one large engine-driven alternators. On the same side of the room are the twenty-one Westinghouse single-phase induction-type feeder regulators on the lighting feeders. The main switchboard is equipped with Tirrill regulators, synchroscope, power-factor meters, frequency meter and the usual complement of instruments. From this gallery pedestal signals, already described, lead to the distant turbines.

The new engine-room is served by a 40-ton Niles motor crane and the old room by a 30-ton Pawling & Harnischfeger crane.

The natural gas obtained at Cincinnati is rather rich in

fuel value, containing 1050 lb. Fahr. heat units per cubic foot. Using this fuel the Plum Street station averages a kw-hour at the switchboard for every 32 cu. ft. of gas burned under the boilers, including, of course, the supply of steam to all auxiliary apparatus.

DIRECT-CURRENT DISTRIBUTION.

The underground district of Cincinnati, which is also the Edison three-wire direct-current territory, is bounded by the Ohio River on the south, Liberty Street on the north, Broadway on the east and Freeman Avenue on the west.

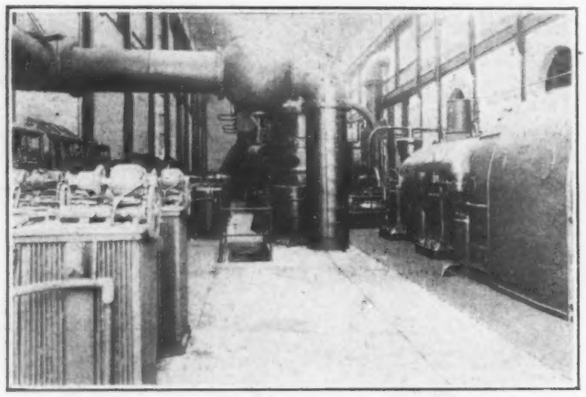


Fig. 6—7200-kw Horizontal Turbine Set, Feeder Regulators and Oil Switches in New Addition.

Feeding into the 110/220-volt network, besides the engine and motor-driven generators at the Plum Street plant, is a substation at Fourth and Plum Streets in the building containing the company's offices. Two 1000-kw motor-generator sets are installed here, besides an 8000-amp-hour, 220-volt storage battery. In the Edison building at Fifth and Walnut Streets there is a duplicate of the battery above mentioned. At the corner of Gano and St. Clair Streets a new substation is now being erected. One 1000-kw and one 1500-kw motor-generator set will be installed at once, while future provision is made for four 1000-kw sets. All motor generators on the Cincinnati system are of the synchronous type, contributing to the improved power-factor characteristics of the system.

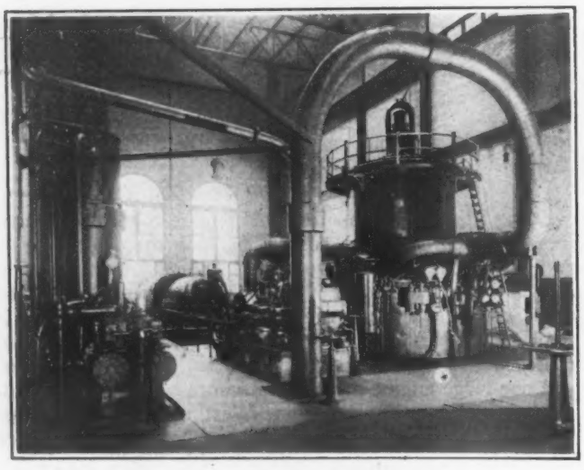


Fig. 7—5500-kw Vertical Turbine Generator in New Addition.

As already mentioned, the contract of replacing Cincinnati's present series alternating-current arc lamps with magnetite arcs represents the largest order for such equipment ever entered. Four distributing points will be provided, the Plum Street group of rectifiers supplying the downtown section, while substations will be located at Price Hill, Walnut Hills and Cumminsville, each station containing from thirty to forty-five of the seventy-five-lamp rectifier sets. These stations are now being installed, and the present plant equipment of thirty-four Wagner 35-amp constant-current transformers, seventeen for the underground and seventeen for the overhead series alternating-current circuits, as shown in the foreground of Fig. 8, is being removed to make way for the new rectifiers. The new lamps will be of the 4-amp type, and the 6000 are to be installed by June 1, 1912. A number of important improvements in this connection have been undertaken by the manufacturer, especially in the design of the station apparatus.

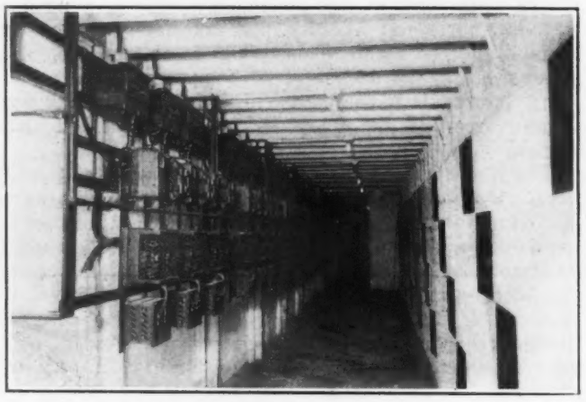


Fig. 8—Feeder-Regulator Relays and Busbar Compartment in Present Plant.

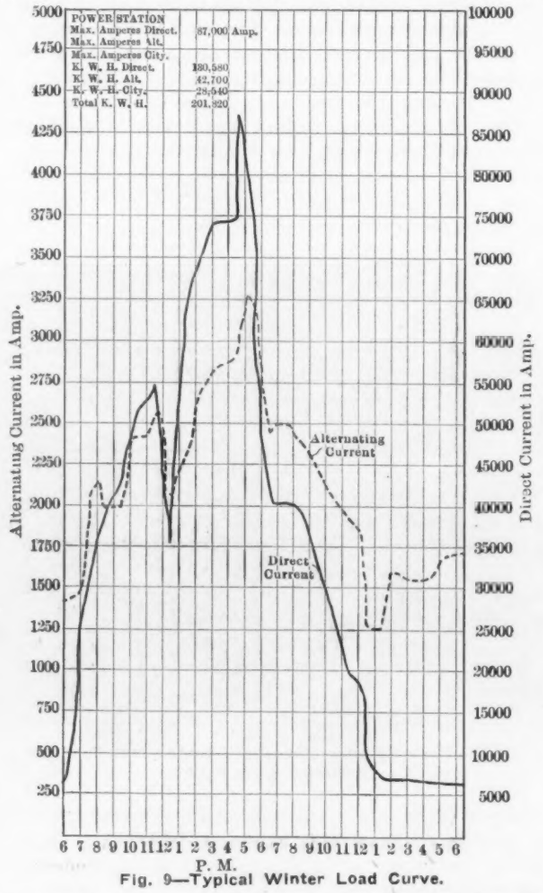


Fig. 9—Typical Winter Load Curve.

Mr. Rollin W. White has been acting president of the Cincinnati Gas & Electric Company. Mr. E. W. McClintock is chief engineer of the Plum Street Station, and Mr. W. P. Vance is chief electrician.

THE PRACTICAL RUNNING OF THE LOCOMOBILE.

Small Combined Boiler and Engine Units of Remarkable Steam Efficiency.—A Coal Consumption as Low as 0.71 lb. per Hp.-hour Recorded.

BY WARREN H. MILLER.

IT was the writer's privilege to visit Germany this summer for the purpose of seeing something of the gas-engine central electric stations of that country and of learning at first hand just how the locomobile was holding its own in actual daily service in all sorts of industrial installations and with the ordinary engine service, such as the saturated steam engine gets under the general run of licensed engineers who are hired in the open labor market for that purpose. I wanted to see whether the great economies obtained under blue-ribbon-test conditions by university professors with trained assistants and expert service were being excelled or even approximated under ordinary conditions of industrial service. Too often a thing that works out all right under intelligent management falls off badly out in the works, because simple or sometimes complicated essentials are neglected or left undone, or else done not wisely but too well. Through the kindness of the two great German locomobile manufacturers, both of whom turn out from 2000 units to 3000 units in a year, I was given every facility to visit plants and ask questions, to judge for myself by what I saw as to how the locomobiles were being handled in every kind of factory and under all sorts of conditions.

The Berlin offices of both Heinrich Lanz, of Mannheim, and R. Wolf & Company, of Magdeburg, put men at my disposal, and I visited the works at both Mannheim and Magdeburg, besides inspecting isolated electric stations in Saxony, Thuringia, the Rhine provinces and Westphalia.

One fact stood out prominently from the very first: the engine being on the boiler both of them must be kept neat and clean, if only for the engine's sake, and, the firemen having been eliminated, the whole plant comes under the immediate care of the engineer-fireman, invariably a man of much greater experience and intelligence than the average fireman. Up to 250 hp one man suffices to run both boiler and engine, and he keeps them both at maximum

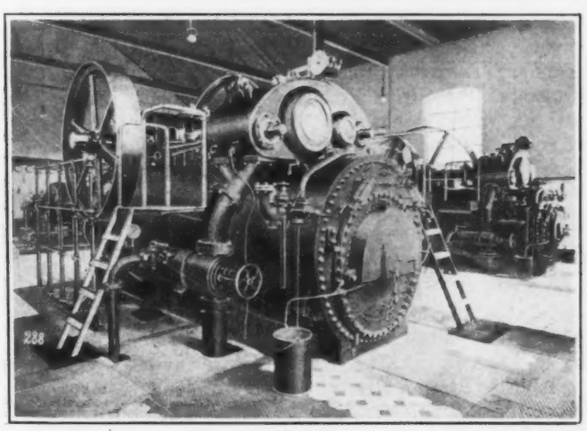


Fig. 1—Two 130-hp Wolf Locomobiles in Plant of F. Ergang, Magdeburg, Germany.

efficiency, thereby saving himself much labor and trouble. In larger units two men are required, but the tendency is to increase the number of units, with one man responsible for each.

The engine and boiler lagging are usually highly enameled and trimmed with polished brass or steel work, all of which is kept wiped down with waste even to the boiler end with its fire door—a refreshing contrast to the usual sooty and ashy boiler front of our firerooms. I never saw a really dirty plant in Germany; in fact, to allow the boiler to become ashy and sooty would mean also the same thing happening to the engine, with consequent hot bearings and their attendant miseries.

It is often urged that the attendance in Germany is of much higher and more intelligent order than that which we get at home. While it is true that the engineer usually

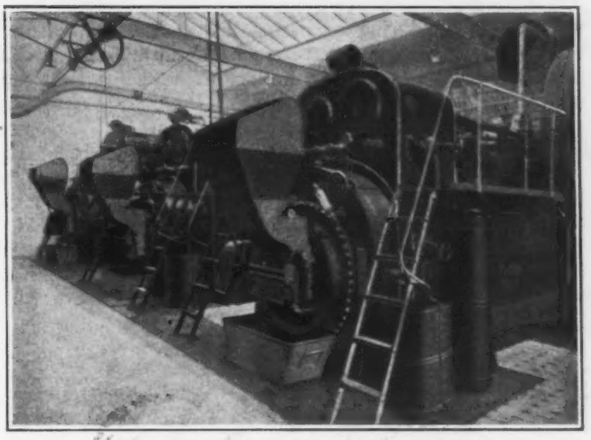


Fig. 2—Lanz Locomobiles at the Berlin Ice Palace.

knew his coal and water consumption more accurately than our average "engineer," the men I saw running locomobiles were exactly the same kind of German mechanics as one finds in our steam plants at home and of about the same qualifications as the Irish or American applicant for the same position.

The fuel used was mostly brown coal (lignite) mixed with one-sixth soft coal or brown coal briquettes, the heat value being about 3000 calories, and the water used averaged 0.5 grain to 2 grains of solids in the United States gallon, being treated outside the boiler and filtered if more than that.

There are a number of features inherent in superheated steam which make running the engine easy compared with saturated steam. There are no water troubles, either from water shots passing the separator or condensed water constantly dribbling out of stuffing boxes, thereby ruining the rods and packing. The oil consumption also is somewhat less than with saturated steam, besides which the engine has such great overload capacity that in time of peak load there is no especial period of labor and anxiety as is the case with saturated steam.

In the Wolf, Lanz and Dresden engines the packing used in all pipe-flange joints, cylinder heads, front and rear boiler heads, superheater valve flanges, etc., is a hard asbestos and fiber packing looking much like leather or papier-mâché. It is manufactured and sold extensively in the United States, though I have forgotten its trade name with us. It is guaranteed up to 400 deg. C. and is easily cut from the sheet and bolt-holed on the job for gaskets. With the Lanz engines no packing at all is used in the cylinder heads, as this company prefers the scraped metal-to-metal joint. I made particular inquiries as to the clearance and the effect of expansion upon it and upon the lap and lead of the valve setting. The clearance allowed is much smaller than with us, being 0.37 mm to 4 mm in large engines and in both high-pressure and low-pressure cylinders. All adjustments for lap, lead and clearance are made at the factory, with the engine hot, with the full steam pressure and superheat of running conditions on, and if altered subsequently should be readjusted when hot. It then makes no difference where the expansion takes them when cold, as they will return to proper adjustment when warmed up.

In the matter of valve-stem and piston-rod packing each

company has its own patent labyrinthine cast-iron ringed piston-rod packing, and in both the cylinder oil is introduced through this labyrinth at a higher pressure than the superheated steam in the cylinder. For the valve stems the Wolf and Dresden companies take advantage of the piston-valve construction to have the exhaust on the stem side of the piston valve, so that the superheated steam never comes in contact with the rod and ordinary metallic packing with a turn of soft can be used. The Lanz company, with its lift-valve gear, must needs allow superheated steam upon the valve stem during admission and its solution of the problem is to make the valve stem labyrinthine and grind it into a cast-iron bushing, no other packing being used. It is tight and will stay so, provided no lime, acids or solids are present in the steam.

At the Ergang boiler and engine works of Magdeburg they were good enough to start and stop one of their 250-hp Wolf locomobiles so that I could see the entire process, and it certainly is simplicity itself. The matter of getting rid of entrained water in the superheater, left there over night, perhaps when the engine grows cold, was another question which interested me. If you follow directions there will

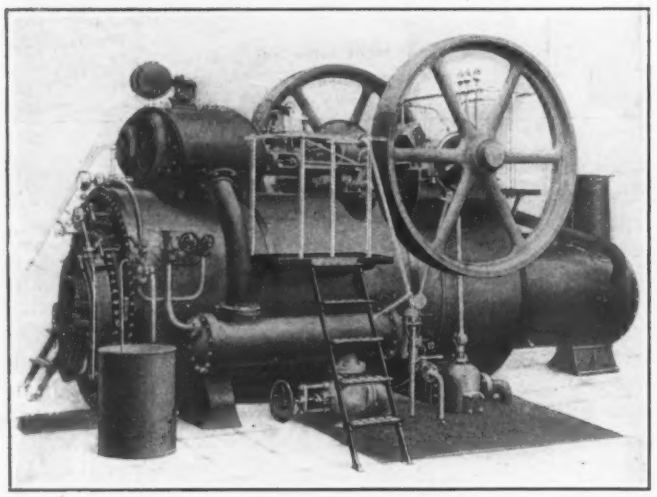


Fig. 3—150-hp Locomobile.

not be any water in the superheater, for the invariable custom is to let down the fires ten to fifteen minutes before quitting time so they can be banked at 6 o'clock, the end of the German day's work. The valve between the boiler and the superheater is then closed and the engine runs down to a standstill and its throttle is then closed. The superheater bleed-valve into the chimney is then opened and all the remaining steam blown out, after which the heat remaining in the grate thoroughly dries out the superheater. During the night it fills up with air. On starting up in the morning the superheater is allowed to heat up to some 300 deg. C., after which the steam is admitted, and as soon as it comes blue from the superheater it is ready for the engine. This is started with the drain open precisely the same as any saturated steam engine. In all plants the steam pressure carried is twelve atmospheres (160 lb.) and superheat 300 deg. C., and this was always lived up to.

There is not room within the scope of this article to describe more than three of the many plants I was allowed to inspect, but these three are quite typical of the results that are being obtained all over Germany, Russia and France. The first of these is the power house of the Ice Palace, in Berlin, containing 550 hp in a group of three locomobiles, compound jet-condensing, one of 150 hp, one 170 hp and one 230 hp normal loading. The three occupy a room 36 ft. x 48 ft. and run the entire electric-light and refrigerating apparatus of the Ice Palace, running time being practically continuous for the ice machines and lights. The electric equipment consists of four dynamos, 60 kw each, at 220 volts, which operate the entire lighting system and charge an accumulating battery capable of handling 360 16-cp lamps. The ice machines maintain a thickness of 12 cm over an area of 2000 sq. m and were made by the firm of A. Borsig, of Berlin, on the sulphurous acid gas (SO_2) system. The cooling is by 20,000 m of brine pipes at — 10 deg. C. There are two of the SO_2 ice machines of 125 hp each, belt-driven from the two flywheels of the 250-hp locomobile. The coal used per day of twenty hours is 15,000 lb., or 1.35 lb. per effective hp-hour, including the steam used for heating the building. It is ordinary soft coal slack, fed by automatic shovel feeders. Two attendants and a chief electrician run the three locomobiles, the switchboard and dynamos and the two ice machines. There are two ten-hour shifts, making a total expense of six men, or $9 attendance, for the entire equipment. The oil consumption in twenty hours was 16 lb. of cylinder oil and 20 lb. of machine oil, the cylinder oil being a special superheated steam oil supplied by our own Vacuum Oil Company. The steam pressure maintained was 11.5 atmospheres on the gages; superheat, 350 deg. C.; cylinder clearance, 2 mm. Tube system and corrugated furnace had been withdrawn and thoroughly cleaned once a year for the three locomobiles, and the superheaters were all cleaned with the steam blast once a day regularly.

Compare this plant in your mind's eye with an equivalent institution at home. We would want, first, a boiler-room with three 300-hp water-tube boilers for 160-lb. pressure, taking an attendance of two men per shift and a floor space of not less than 38 ft. x 60 ft., allowing an economizer to utilize 6 ft. of back and alley. Next we would want an engine-room 30 ft. x 60 ft. and a wing to put the ice machines and their condensers in, which latter wouldn't count, as the same thing is done at the Berlin Ice Palace. To attend this equipment two oilers and a chief would suffice, or ten men for the two shifts, aggregating in wages $27. Our coal would be about 2.5 lb. per effective hp-hour; say, 30,000 lb. per day—a very modest estimate—or $45. Total American cost, exclusive of oil, $72; total German cost at Ice Palace, $31.50. If we were to use a locomobile installation with saturated steam we should undoubtedly have far less bother and trouble, save the wages of four firemen and cut the coal bill in half, besides reducing enormously the initial expense of installation.

The next example is the central power station of the boiler and machine works of F. Ergang in Magdeburg. This company makes a specialty of tanks and brewery apparatus of light ⅛-in. sheet iron, soldered in seamless joints with the oxyhydrogen blowpipe, the so-called Autogen process of the Sirius Company, Dusseldorf. During the last ten years it has bought steadily larger and larger locomobiles from the Wolf company. It has a number of these in the works and three in the central power station, the largest being 250 hp normal loading and 300 hp maximum. The load fluctuates all the way from 50 to 300 and consists of factory shafting put on by a clutch, a power dynamo and a light dynamo. The week's coal consumption was 30,000 lb. of brown coal (lignite) of 2500 calories mixed with 5000 lb. of soft coal screenings of 6000 calories; running day, eleven hours, making the brown coal per effective hp-hour 2.1 lb. The steam pressure carried was twelve atmospheres; feed water, 45 deg. C. Boiler tubes are withdrawn for cleaning once in two years. The company used Magdeburg city water, passing it through a water-softening and filtering plant, which gave it the above excellent results with 3½ kilos of lime and 2 kilos of soda added to the city water per day before filtering. The soot on the superheater was cleaned off with the steam blast as with other plants. The big locomobile had shut down for the night when we arrived and its grate was clean, though still hot (grate surface, by the way, about 5 ft. long by 3 ft. 6 in. wide). At the instance of my host, Lieutenant von Hazebrouck, of the Wolf company, it was started up again. It took the engineer about three minutes. He

opened the cylinder drain cock, opened the superheater valve, closed the superheater drain and opened the main throttle, and in a few seconds the engine was up to speed. Next he put on the jet condenser, the vacuum took hold and we were in normal running shape. The reverse of these operations took place on shutting down. The superheater drain led into the chimney, where the noise and vapor of it would be out of harm's way, but by opening a chimney door we were able to observe it. Outgoing steam was a clear blue at the nozzle.

The plant of Glauer & Company, screw works, Magdeburg, is interesting in showing the economy of a 165-hp normal Wolf locomobile, running at 100 hp or two-thirds load on brown coal briquettes of 5000 calories heat values. Consumption was 20,000 lb. of briquettes in sixty hours at 100 hp, twelve atmospheres pressure and 0.85 vacuum; feed water, 55 deg. C.; cooling water, 3 liters per hp-hour. The briquette consumption then figures 3.3 lb. per effective hp-hour, which is excellent for an engine on less than two-thirds normal rating with an ash residue of 12½ per cent. It is equivalent to 2.8 lb. of brown coal, or 1.4 lb. of soft coal, per hp-hour and bears out in practice the test indications that at underloads superheated steam engines lose very little in efficiency. This engine drove a 170-kw, 220-volt, direct-current generator to supply energy to the motors in the works.

As to general types of locomobiles, with the Wolf company the tandem-compound, direct-current, with double superheat and both high-pressure and low-pressure cylinders jacketed by the chimney uptake is the present favorite. There are many of them to be seen running in Berlin, Magdeburg, Mannheim and throughout Westphalia. This type holds the world's record for low coal consumption—0.71 lb. per hp-hour. There were a number of them being built on the erecting floor in Magdeburg when I was there. The smaller and older type, running from 40 hp up to 83 hp tandem compound, with the high-pressure cylinder in the uptake and the low-pressure cylinder in the steam dome, is also very popular, particularly in Russia, where most of them are sold. It has a high economy, 7 lb. to 8 lb. of steam, and is very light, so that the Russian duty, which is by pound weight, is less. The Lanz company and also the Dresden company build only one type of locomobile, preferring a high superheat and one superheater coil to low superheat and double coil, one for the low and one for the high, as with the Wolf. To obtain the same economy the Lanz engine must have considerably higher superheat, but it has its compensation in the single superheater coil. It remains for the future to show which type will become the most popular in our country.

2300-VOLT MOTORS IN ZINC MINES AT JOPLIN, MO.

Service Rendered in 125 Different Mines for Pumping, Hoisting and Other Operations.—Methods of Carrying High-Tension Cables Down the Shafts.

THE famous Empire District of Missouri and Kansas, centering about Joplin and Galena, produces about $15,000,000 worth of lead and zinc ores yearly. A large number of the mines and mills in this district are operated electrically from the transmission network of the Empire District Electric Company, whose 37,000-hp system, including steam, water-power and gas-engine plants, was described in the *Electrical World* of Dec. 1, 1910.

For supplying the large quantities of energy used in the mines and mills, the Empire District company has developed and standardized the practice of using 2300-volt motors for all sizes above 30 hp. Of particular interest is the fact that a number of these primary-motor installations are used for pumping duty in the mines themselves, 200 ft. to 300 ft. under ground, amid conditions of moisture and loading about as severe as can be imagined imposed on high-voltage electrical machinery.

Practically all of the mines in the Empire District have to be pumped to free the lower levels of water, and on account of the intercommunication of the lower strata the pumping of one mine will often drain others, so that the cost of running one mine pump is sometimes shared by several neighboring owners. These mine pump motors range in size from 50 hp to 150 hp and drive centrifugal pumps which take water from collect-sumps. These sumps are usually large enough to retain at least several hours' seepage into the mine, so that the chambers will not fill should the pump be out of service for a short time.

For conveying the 2300-volt, three-phase cables down the mine shafts, which are usually of the rough rock and not

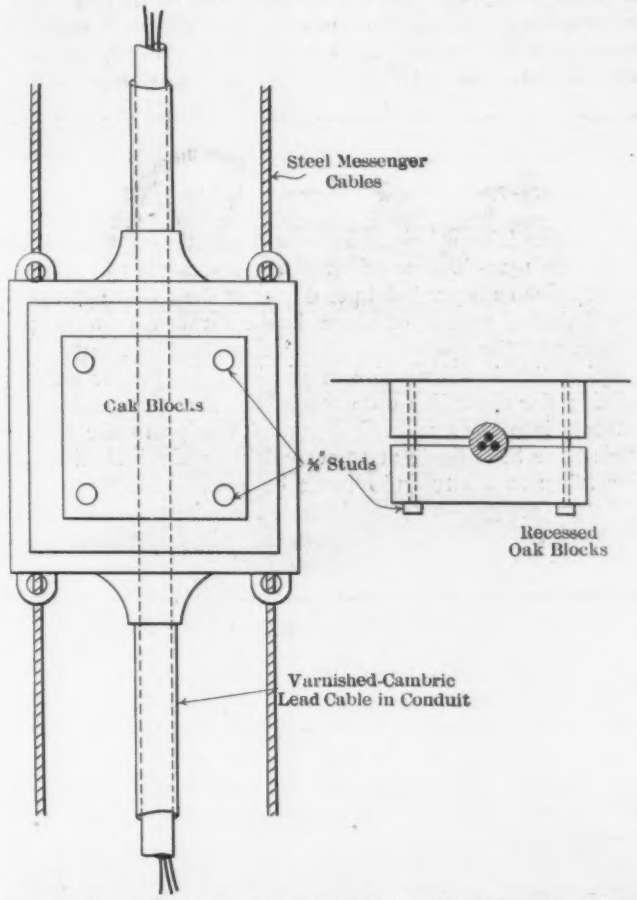


Fig. 1—Supporting Boxes for 2300-Volt Cables in Mine Shaft.

cribbed, the power company has developed the arrangement of conduit and cable boxes shown in the accompanying sketch. Lead-covered, varnished cambric three-conductor cable of No. 4 or No. 6 cross-section is used, this cable being carried by iron conduit for mechanical protection against injury. Some of the vertical drops from the surface to the pump level are 225 ft. in depth, and to support the cable down these shafts cable clamp boxes, as illustrated, are introduced at intervals ranging from 30 ft. to 40 ft.

These cast-iron boxes, 12 in. square and 7 in. deep, have their end bells threaded to screw on to the conduit pipe and each contains a pair of recessed blocks of oak which are clamped together by ⅝-in. stud bolts screwing into the box casting. These blocks grip the cable firmly, without injury, supporting it throughout the short lengths of 30 ft. to 40 ft. between boxes. The doors of the boxes are fastened on with screws and all joints are puttied. On the back of the box castings are lugs, to which are fixed the steel cables supporting the series of boxes from the

top of the shaft. The 2300-volt cables are carried in conduit directly to the motor, which may be several hundred feet distant from the entry shaft.

Where steam-driven hoists have been replaced by motor drive in the Empire District substantial gains in speed and economy have been recorded. For example, the American Davy mine at Joplin, after installing a pair of 75-hp, 220-volt motor-driven hoists, is now hoisting on each shift about 600 1400-lb. cans of rock per day, a gain of fifty to seventy-five cans per hoist per day over the steam operation. The hoisting speeds of these buckets reach 1500 ft. per minute, and the operator acquires considerable dexterity in stopping this headlong rise at precisely the proper instant, hooking the upset line onto the bucket and discharging the contents into the crusher. Successive trips to the 250-ft. levels have been made at 32-second intervals, including the time taken to empty and change buckets.

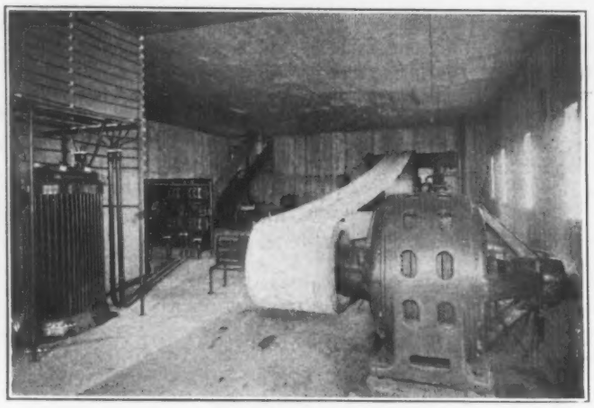


Fig. 2—Typical Mine Substation in Joplin District.

Motors are generally used about the mines for operating the crusher rolls, jigs, slime-tables, air compressors for drills, etc. Curiously (on account of the open nature of the ground) no electric drills have been found to work satisfactorily in the Joplin district, although many are in practical use elsewhere. Fig. 2 shows the interior of a typical mine substation, revealing the excellent and permanent construction which characterizes these installations. The large motor shown drives an air compressor, and in the background is another motor which operates the mill. These are 2300-volt machines, but for services smaller than 30 hp 220-volt motors are used about the mills and in the mines. No 440-volt motor distribution is permitted in the mines, since it is believed that a shock from this alternating-current pressure would be quite as serious as from a higher voltage, while not inspiring the men with the caution insured by the 2300-volt service. The small 220-volt motor shown underground in Fig. 3 was originally installed for operating a small pump. It has later been applied to pulling the cable drawing the can cars laden with ore from the working face of the mine to the shaft. By means of the belt shown the little motor is thus used to convey material during mining hours and then to pump water at other times, so that it is in almost continuous service.

Fig. 3—220-Volt Motor Operating Small Pump and Can-Car Railway in Mine.

The Empire District Electric Company's 37,000-hp, 25-cycle system, which includes steam, gas-engine and water-power plants, is connected by a network of over 100 miles of 33,000-volt transmission lines. The transmission voltage is reduced by nineteen different substations at various points, the smallest of these substations having 500 kw rating. The towns of the district, aggregating a population of over 100,000, are lighted by the Empire District Electric Company, two-phase, 60-cycle energy being supplied for this purpose by motor-generator sets.

The company's total motor load now aggregates 16,500 hp, made up from among 125 different mine customers, whose connected rating ranges from 50 hp to 1500 hp; the power requirements of 115 miles of interurban railway, and the commercial power load of Joplin, Galena, Webb City and Carterville. All energy is sold by meter on a demand schedule, the amount being billed to mine customers in hp-hours instead of kw-hours, since the mine operators prefer to deal with the former more familiar and easily understood term.

Mr. George E. Hayler, Jr., is general superintendent of the Empire District Electric Company, which is one of the Doherty properties.

MOTOR-OPERATED LIFT BRIDGE.

A Span of 425 Ft., Weighing 780 Tons, Lifted by Direct-Current Motor of Crane Type.

The great new Fratt bridge, which is now being completed across the Missouri River at Kansas City, is operated by electric motors and is arranged to clear river steamboat traffic on a lift principle quite unique among movable spans.

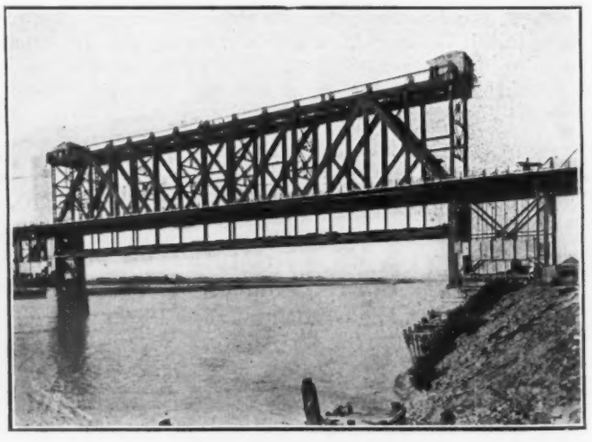


Fig. 1—Motor-Operated Lift Bridge at Kansas City, with Movable Deck Half Raised.

Besides the unusual provision of its movable lower deck, the 425-ft. main span, carrying two railroad tracks, two electric-car tracks, a railway, and foot paths, also has the distinction of being the longest riveted span ever built.

As shown in the illustration, the bridge is a double-decked structure, the lower platform of which, carrying the railroad tracks, can be drawn up against the main bridge floor

by steel cables which pass over motor-operated drums and sheaves and are counterbalanced by great concrete weights.

The lower deck is divided into fourteen panels suspended by vertical hangers from the truss chords when the deck is lowered into normal position. From each of these uprights 1.25-in. steel cables pass up over 5-ft. sheaves on the top chords and thence over the drums to the counterweights.

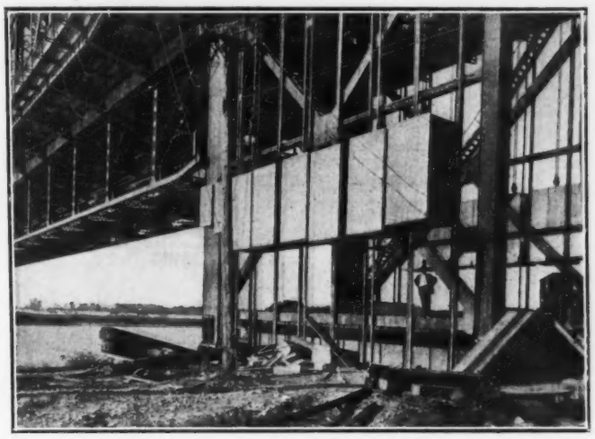


Fig. 2—Huge Concrete Counterweights Operated by Two 250-hp Motors.

The deck has a vertical rise and fall of 46 ft., clearing the water by 65 ft. when in its raised position. The work of raising the deck is done by two 250-hp, 550-volt grounded-return Westinghouse direct-current crane motors, either of which is able to move the deck singly. These motors are mounted in the housings on the ends of the span and each drives its drum, over which pass all the cables of the adjacent half of the bridge. These cables, as shown, make only 90 deg. or less arc of contact on the winding drum.

To enable either motor to operate both halves of the bridge, should the other motor be injured, the two winding drums are themselves interconnected by cables and move synchronously, assuring that all parts of the deck shall rise together. The dead load of the deck is conterbalanced by thirty-two huge concrete blocks, most of which weigh 25 tons each. As constructed the bridge is stable in any position, so that the motors are required only to move, but not to lift, any part of the structure. This type of bridge also avoids the heavy wind resistance encountered in swing and bascule bridges, which represents a large part of the work done by the motors in moving those types of bridge. The deck structure is of nickel steel, having the same strength as a deck of ordinary carbon steel weighing a third more. As built, the total weight to be raised is about 780 tons, while including the counterbalances the total mass moved is about 1500 tons through 46 ft.

Either or both of the 250-hp main motors can be controlled from either station at opposite ends of the bridge. These motors are fitted with magnetic brakes which are automatically applied when the motor circuit is opened.

When the deck is in its normal lower position its steel parts are securely seated and the cables are relieved of carrying all except their counterweight loads. To fix the deck securely in position it is held down by twenty-six interior locks and two end locks, all operated through a system of rods and bell cranks by a 15-hp motor. The end locks are provided with large bearing surfaces for taking the brake thrusts of moving train loads on the deck. The interior locks are made up in the form of suspended segments which can be swung together to arrest the bridge motion or opened to allow it to be raised.

The proper seating of the various panels is reported at the operators' houses by lamps having their circuits made up of contacts in series at each panel. In this way the lamps remain extinguished until the last panel is in position. To prevent overrunning of the motors in raising or lowering the deck their control circuits are equipped with limit switches in the form of worm-operated contacts, opening the circuits when the deck reaches the end of its travel.

The movable span is one of three bridging the water, which, with the steel-viaduct approaches, make up the total length of 4150 ft. of steel structure. The upper deck is at the level of the Kansas City streets, the purpose of the bridge being the opening up of a large, now unused territory lying north of the river and very near the center of the city. The lower deck is at the railroad grade, but as the Missouri is a navigable stream a clearance of 55 ft. is required by the government.

The new bridge will be operated with central-station energy from the Missouri River power plant of the Kansas City Electric Light Company, near its south approach.

The firm of Waddell & Harrington, who have designed many famous movable bridges in this country, among them the Halsted Street lift bridge at Chicago, designed the Kansas City structure, the unique features of which are the patented invention of Dr. J. A. L. Waddell.

ELECTRIC DRIVE IN A LUMBER MILL.

Thirty Induction Motors Installed.—Power Data of Woodworking Machinery.

One of the most complete motor-driven industrial plants in Salt Lake City is the lumber mill of Morrison, Merrill & Company, which is supplied with power by the Utah Light & Railway Company. The establishment is one of the most

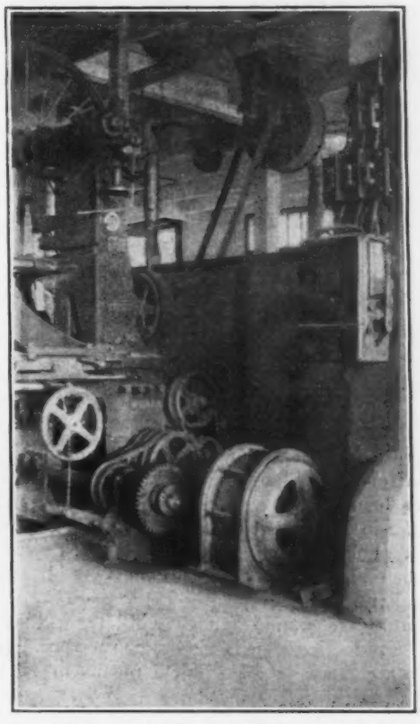


Fig. 1—Motor-Driven Band Rip-Saw.

prominent in the State and has been using electric power in a small way for about five years. Recently the expansion of the company's business necessitated the building of a new mill at the intersection of First North and Third West Streets, and after an investigation of the merits of individual-motor driving it was decided by the owners to install electricity throughout the establishment, providing a

separate motor for every machine in the place. Over thirty motors, aggregating about 225 hp in total rating, are in service, all being of the induction type and varying in size from 1 hp to 35 hp. A list of the machines driven and the ratings of the corresponding motors is given in the accompanying table.

The original lumber plant of this house contained about 58 hp in motors, and the success of this method of driving was so pronounced that electricity received favorable consideration when the present building was erected a few months ago. The mill building is practically 100 ft. square and is constructed of concrete and brick, with interior mill type of framing, having two stories and a basement. Energy is brought to the plant by a 220-volt, three-phase circuit, carried along the exterior of the building from a step-down transformer installation mounted on a pole in the yard. The circuit enters the building in iron conduit and passes to a switchboard mounted in a glass-incased frame on panels hung about 10 ft. from the floor and reached from the latter by a short stairway, no floor space being required

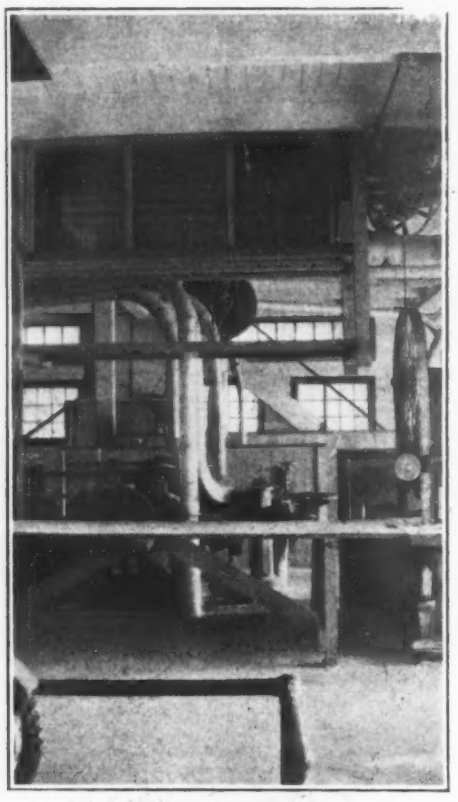


Fig. 2—Switchboard.

for the fuse, switch and meter installation. The switchboard platform is about 9 ft. x 4 ft. x 1 ft. in dimensions, the meter being readily accessible. The platform is supported on 2-in x 4-in. floor timbers and carried from above by 4-in. x 4-in. uprights. The current coil of the meter is inclosed behind the glass casing of the switchboard in front of the busbars.

All motors are wound for 220-volt, three-phase service and, as the induction type is used, such speed changes as are necessary are made by mechanical means at the different machines. All local-distribution wiring is run in conduit. The heaviest machines in the plant are equipped with exhaust fans for shavings and sawdust, run by the regular driving motor. In many woodworking establishments the exhaust fans are run even when the machinery is shut down, raising the power consumption unduly. The arrangement of the fans at the Morrison-Merrill plant, as above noted, has resulted in attractive savings in power. The plant operates nine hours per day, and the absence of belts and line shafts has been found to result in greatly improved conditions of production. The company collects all the dust and shavings from its machines in a system of galvanized-iron pipes, which ultimately discharge into a 14-in. trunk line leading to a neighboring refrigerating plant about 200 ft. distant. The latter establishment burns the refuse in its boilers and supplies steam heat to the woodworking plant, no boilers being in use on the premises of the latter. So far as possible motors are located on the ceiling of either the basement or the first story, geared and short belt drives being freely used. The compactness of the installation from the point of view of the motive-power engineer is noteworthy. Headroom is preserved for production service, giving a maximum freedom in handling long pieces of timber, both by team and by hand. The direct drive insures steady output, which is specially important in a business where skilled labor plays so essential a part. The cost of energy is about 15 cents per 1000 ft. board measure handled in the machines, and electricity has kept out steam, despite the availability of free shavings.

TABLE OF MOTOR DRIVES, MORRISON, MERRILL & COMPANY, SALT LAKE CITY.

Machine.	Motor		
Column lathe	1- 3	hp	1,700 r.p.m.
General blower	1- 5	"	1,700 "
One 6-in. double-head double-cope tenoner, Hawley & Hermance	1- 5	"	1,700 "
One double-spindle emery wheel	1- 1	"	1,700 "
One Hall & Browne 4-in. sash sticker	1- 5	"	1,700 "
One American hollow-chisel mortiser and relisher	1- 3	"	1,700 "
One New-Britain Machine Company No. 7 chain mortiser	1- 5	"	1,700 "
One 49-in. 3-roll Berlin Sander No. 24 and 1 12-in. Oneida blower	1-25	"	900 "
One 108 Berlin molder and 1 12-in. Oneida blower	1-35	"	900 "
One 281 Berlin band rip saw	1-15	"	1,200 "
One 8-in. sash sticker and Oneida blower	1-10	"	1,200 "
One self-feed rip saw	1- 5	"	1,700 "
One arm sander	1- 3	"	1,700 "
One 36-in. band saw	1- 3	"	1,700 "
One window-frame machine with cross-cut saw.	1- 3	"	1,700 "
One double head shaper for sash work	1- 5	"	1,700 "
One Berlin rip saw, No. 226	1- 3	"	1,700 "
One swing cut-off saw	1- 5	"	1,700 "
One slasher cut-off saw	1- 3	"	1,700 "
One 24-in. joiner, Berlin No. 199	1- 5	"	1,700 "
One rip saw	1- 5	"	1,800 "
One small variety saw	1- 5	"	1,800 "
One window-frame pocket machine, double-head rip saw and double cross cut	1- 5	"	1,700 "
One 18-in. Berlin planer	1- 7½	"	900 "
One Dado machine	1- 3	"	1,700 "
One small drill press	1- 2	"	1,700 "
One jig saw	1- 2	"	1,700 "
One small rip saw	1- 3	"	1,700 "
One 20-in. joiner	1- 3	"	1,700 "
One freight elevator	1- 7½	"	1,120 "
One 30-in. surfacer (double), Berlin No. 177	1-35	"	900 "
Four small machines not accounted.			

COST OF ENERGY

April 8 to May 9, 1911, consumed 3,650 kw-hours, rate 3.8 cents equals one month. Maximum demand, 65 hp. $138.70

CURING MEATS WITH THE AID OF ELECTRICITY.

Time of Curing Bacon Reduced by Electricity from Eighteen or Twenty Days to Three or Four Days.

Hams are ordinarily cured by pickling from ninety to 100 days in a solution of salt, sugar and saltpeter, during which period they must be frequently changed in position. A Cincinnati packer has discovered, however, that if 60-cycle alternating current be passed through the brine containing the hams the pores of the meat are opened to the fluid and the same hams can be completely cured in from thirty to thirty-five days.

This effects a considerable saving in plant space, material, labor and investment, and the product obtained equals in all respects the naturally pickled ham. Of special interest in this regard is the fact that the packers, J. C. Roth & Company, pride themselves upon the unmatched flavor obtained by their secret pickling formula, a priceless

heritage handed down through several generations, and therefore would hardly permit any mere advantage of saving time to affect the unique local reputation of their product.

The green hams to be cured are piled on trays in wooden vats, 16 ft. x 4 ft. x 5 ft., each vat holding about 5000 lb. of meat. At the ends of the vats are the electrodes, each

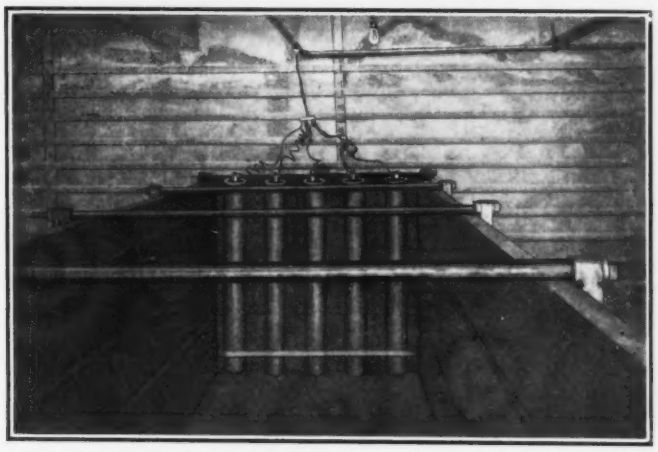


Fig. 1—Interior of Curing Vat, Showing Set of Electrodes in Tile Tubes.

set comprising five 3½-in. carbon cylinders 4 ft. long, inclosed in unglazed 6-in. tubular tiles. The vertical arrangement of these electrodes and their connection to the lead wires are shown in Fig. 1, from a photograph of the interior of the vat. After the hams are in position the brine, held at a temperature of 34 deg. to 36 deg. Fahr., is turned into the vat and kept circulating by motor-driven pumps on the floor below. From the switchboard a current strength of 30 amp to 35 amp, 60-cycle alternating, is turned through the vat, the drop in potential between the opposite sets of electrodes being about 40 volts. This discharge is usually continued throughout the pickling period of a month or more, although recent experiments seem to show that equally good results are obtained by using the current flow alternately twenty-four hours on and twenty-four hours off. In the same way bacon, which ordinarily requires eighteen to twenty days, can be completely cured in three or four days.

The Roth plant now has ten of these 5000-lb. electric vats in continuous service. The company operates its own 100-kw direct-current steam plant, and alternating current for energy for pickling is obtained through an inverted

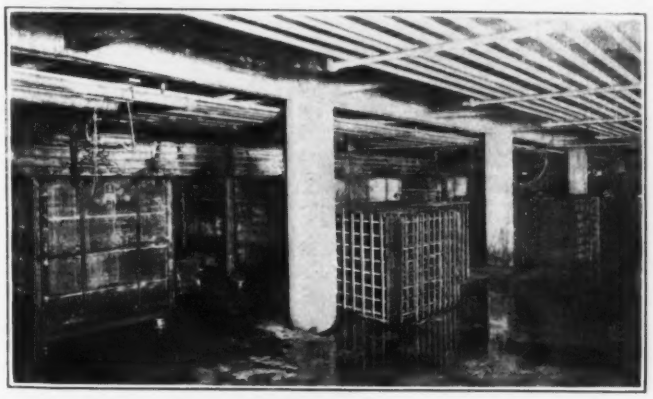


Fig. 2—Row of Ten Electric-Curing Vats in Roth Plant.

rotary converter. By means of face-plate contact arms the strength of current flowing in any circuit can be adjusted, and an intermediate position of the vat switches cuts the ammeter in circuit for making the current adjustment.

The present curing vats have been in use nearly a year, and are the result of nearly four years' experimenting at the Cincinnati plant. During the course of these tests direct current was first used, but the products of electrolysis liberated at the electrodes fouled the solution and caused changes in its composition. With alternating current these effects are avoided, but the pore-opening action remains. The new vats and electric-treating apparatus were built by the Electric Meat Curing Company, Cleveland, Ohio, which is now planning several other installations of the principle.

Electricity plays a number of other important rôles around the Roth plant. From the pickling vats the hams are hauled to the smokehouses, 1400 ft. distant, by two 110-volt one-ton locomotives. The trucks used have 24-in.-gage grooved wheels for running on the tracks, but when trundled along the floors their large rubber-tired wheels are brought into use. The company's modern garage contains six electric trucks, from 1-ton up to 10-ton capacity, and a number of electric runabouts for its local salesmen. All elevators in the building are of the automatic electric type, and motors are used for slicing meats, crimping extra covers on cans for long-distance shipments, branding hams, operating vacuum conveyor systems, phonographs, mailing machines, adding machines, etc. The offices are heated in winter by thirty-five non-luminous resistor-type radiators. The various refrigerating brines and pickling liquors are handled by motor-driven pumps, and in the roof garden is a large swimming pool, holding 17,500 gal., water for which is pumped electrically. The presence of this pool has an important fire-insurance value to the building. Children of the employees and neighborhood are welcomed to this airy playground, while for their elders on the floor below there is an auditorium with a stage and large electric organ.

FEEDER-LINE CONSTRUCTION AT CINCINNATI.

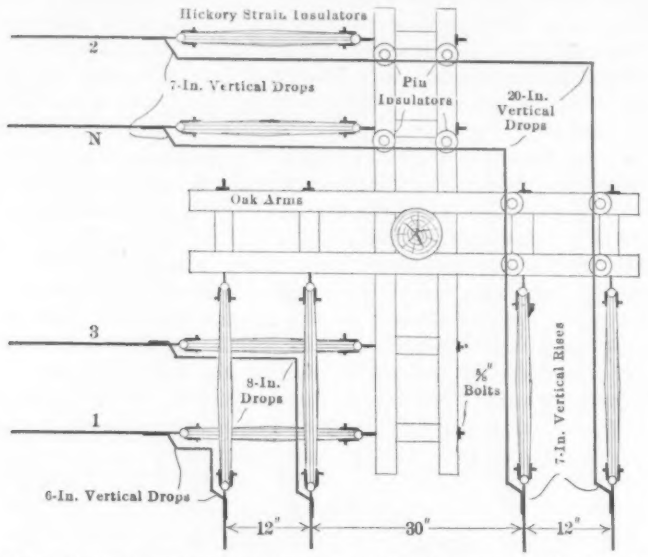
Method Whereby Life of Pins is Trebled.

For making turns on its 4500-volt No. 00 feeder lines the Cincinnati Union Gas & Electric Company has adopted the rigid, dead-ended construction shown in the accompanying sketch. Whereas the life of the former pin-type construction was barely three years, the strain-bolt type bids fair to last ten.

As illustrated, all wires are dead-ended to wood strain insulators attached by ⅝-in. bolts inserted through the oak arms, the unbalanced stresses being in turn transmitted to guy lines attached to the ends of the cross-arms. The stiff-wire jumpers used to connect between the dead-ended lines are bent accurately into square turns on the ground, and when in position are supported on insulators on the outside of the turns, as shown. The whole construction is thus made rigid, and the appearance is very pleasing. Hickory strain insulators are used, made in the company's own shops. These insulators measure 2½ in. in maximum diameter and 26 in. between the eyes formed by their end straps. The cross-arms for corner work are of oak, 3¼ in. by 4¼ in. in section, and are slightly longer than the standard arm. The wide clearance, 30 in., between pole pins contributes to the convenience and safety of linemen. Joints between jumpers and line wires are wrapped and soldered. As shown, the short inside jumpers are without support, but the outer ones are carried up and over insulators on the cross-arms. The ⅝-in. strain bolts are cut extra long to permit adjustment for slack, etc.

On the poles next to each turn, branch or other departure from the straight construction the phase wires are clearly designated by porcelain numbers screwed to the cross-arms. Painting the numbers on the arms was found expensive and unsatisfactory, as the figures were not durable. The porcelain numbers, white on a blue background, can be changed as desired, and may even be allowed to fall from

the pole tops without injury. A test for proper porcelain material, according to Mr. F. R. Healey, line superintendent of the company, is a sharp hammer blow on the face of the letter. If the porcelain cracks from the metal



Dead-Ended Construction Used on Feeder Turns at Cincinnati.

in large flakes the material is poor, but if the coating adheres tightly except for small cracks at the point of concussion the figures may be accepted as fit for the rough use of line work. These letters are also placed at intervals in very long, straight runs, so that in case of trouble linemen will not be required to go far to identify the phase positions. Cross-arms of Washington fir are used on such straight-away construction.

SOME NOTES ON PUMPS.

By W. H. Wakeman.

Fig. 1 illustrates one of a pair of duplex pumps that are used on light service. Water flows to them under 20 lb. pressure, and they raise it to 45 lb. for use in a large building. If it was necessary to raise this water 15 ft. or 20 ft. by suction large air chambers would be considered essential, but none were included in the original equipment, except one on the combined discharge pipe. The valve shown in the illustration is provided to shut off the supply when the pump must be packed, etc. One of these pumps is sufficient for the service required, but two were installed to insure continuous service, which is an excellent plan, as it enables the engineer to take better care of them than is possible with only one in use, as he can shut down one at any time and use the other.

Although water flowed to these pumps under pressure, they were noisy part of the time when only one was in operation, and therefore the other was also started to afford temporary relief from the shocks and jars, but this was not satisfactory. An air chamber made of 4-in. pipe was put on opposite to the inlet pipe, as shown, and it proves to be a great improvement, as either of them can be run faster than before with but little noise. It was much less trouble and expense to locate this air chamber as illustrated than to cut it into the supply pipe, and it could not do better work than it does in its present location, because it cushions the suction chamber, thus preventing the ram-like action that would otherwise take place when the body of water in that pipe, especially where it is straight for many yards, is started into rapid motion, and then suddenly checked by the pump.

Fig. 2 shows the water piston of a hot-water pump that is packed with fibrous packing. One day I noticed that the pump from which this was taken was running much faster than usual with the ordinary load. Investigation showed that nearly all of the packing was in good order, but there was a groove cut completely across it, as shown at 2, thus forming a passage which caused excessive "slip." It is my custom when packing such a pump to put the joint in the first ring at the top, the second directly opposite, the third at the right hand and the fourth at the left hand, thus "breaking joints" effectually. To allow for expansion of the packing rings when soaked in hot water the joints were

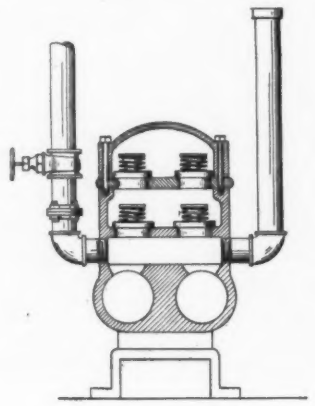


Fig. 1—Duplex Pump.

left open ⅛ in. or more. See Fig. 3. This formed a weak spot, and water entering here had succeeded in cutting a groove through the three other rings. Although this custom had been followed for several years this was the first failure of the kind noted, but ever since that experience the joints are made as illustrated in Fig. 4, without regard to expansion of the packing.

The packing in this pump is "set out" or expanded by a tapering nut screwed on the rod. Another pump in this plant has only stiff rings of packing, without any device to prevent them from collapsing, except a thin brass band that is not worthy of consideration. Still another is fitted with a solid bronze piston, except the follower plate, which is put on separate and held in place by a nut. See Fig. 5, which contains no packing. When this is in the water cylinder it leaves a space ¼ in. wide in which to put the packing. For hot water it is desirable to use square duck packing, but this must be just the right size to fill the space, or it will leak badly, as no means are provided for adjusting it. While it can be forced into place, it requires more or less skill to do it, also a fair stock of patience, especially if time for doing the job is limited and the limit is nearly reached. Where packing can be put in comparatively loose and expanded afterward it is much more convenient, but it affords an ignorant or careless engineer a chance to expand it too much.

Fig. 6 illustrates the worst-scored pump piston rod that

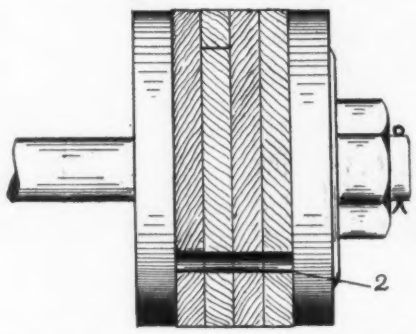
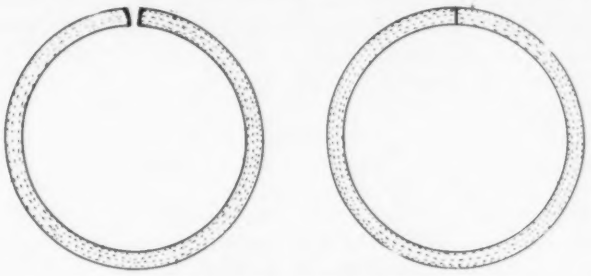


Fig. 2—Water Piston of a Hot-Water Pump.

I ever saw. Hot water from a heating system was delivered to a receiver, to which this pump was connected through a pipe that was buried in the ground for several rods. Sand came into the receiver with the hot water, but

whether this was due to an imperfect joint or to a corroded pipe will never be known. The pump was nearly new, but the rod where it went into the water cylinder was worn down 1/5 in. by actual measurement. While this does not appear to be very bad when stated as a fraction of an



Figs. 3 and 4—Joints in Packing.

inch, it looks a great deal worse when the rod is examined, especially when the full diameter is only 1⅛ in.

The steam cylinder of Fig. 7 is 8 in. in diameter. The water plunger is formed by continuing the piston rod into the water cylinder, according to common practice, but there is no piston on the end of it, and, considering that it is only ¾ in. in diameter, it is an easy matter to secure a very high water pressure. This constitutes an outside packed plunger pump of the hydraulic style, because the total force of steam acting on an 8-in. piston, minus the friction load, is exerted on a ¾-in. plunger. It is used to operate the rams in a pair of lumber dry kilns, to which it is connected by ordinary pipe and valves. Sometimes the water pressure

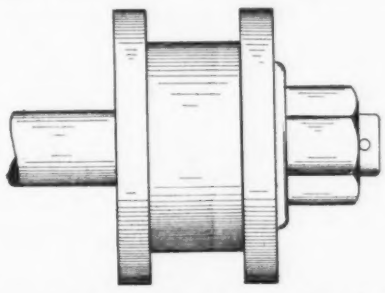


Fig. 5—Method of Installing Packings.

is raised until the pump stops with 60 lb. steam pressure. Why does not this burst these connections?

The owner of this plant installed one dry kiln complete, and several years later another was added. The pumps were run by laborers or whoever happened to be available for the purpose, and consequently became dilapidated in appearance and very uncertain in action. I dismantled both of them, selected the best parts of each, had some of them repaired and made one good pump out of the pair. This was connected to both kilns, consequently each was operated when wanted. This was practical because neither was pumped up more than about twice per week and both were not required at the same time.

Fig. 8 is an oil pump that is used to force oil into the steam pipe of a duplex pump. This pump takes hot water from a receiver in the usual way, and therefore it is controlled by a balanced valve opened and closed by a float. The oil pump shown is connected on the boiler side of this valve because it requires lubrication about once each day. When this pump was new it worked hard, but no special

Fig. 6—Pump Piston Rod.

attention was given to it, because it was expected to move easier as it grew older. On the contrary, it worked harder, and finally but very little oil could be forced through it.

The internal construction and condition of it are shown in Fig. 9. In this connection the reader should remember that oil is pumped downward through the passages shown against steam pressure; hence, whenever the plunger (which is not shown) is drawn upward oil would be blown

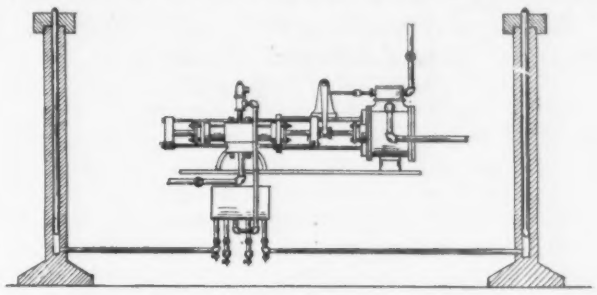


Fig. 7—Outside-Packed Plunger Pump.

out if means were not provided to prevent this action. With the needle valve open the plunger is brought downward, forcing oil through the upper check valve, which is thus carried downward against the action of a spiral spring. When the plunger is drawn upward oil cannot follow it, because this check valve closes. Below the needle valve there is a ball check valve, and this caused the trouble mentioned. The ball had worked down into the spring, as illustrated, until it was below the center, and when oil flowed down it took the ball and entirely closed the lower

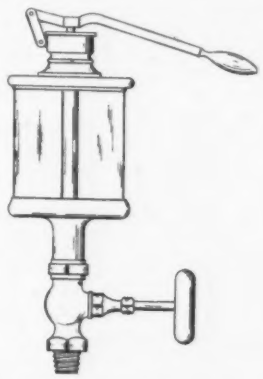


Fig. 8—Oil Pump.

opening; hence only a few drops escaped, after which no more could pass. The bushing 3 was taken out, the ball removed from the spring and placed on top of it, where it now forms a perfect joint and prevents oil from going upward when the needle valve is opened, but allows oil to pass downward freely. This defect was undoubtedly due to ignorance on the part of a workman in the shop where

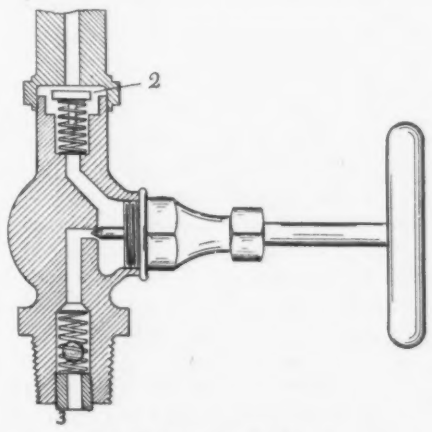


Fig. 9—Section of Valve.

this pump was made, as the ball remains in its proper place and oil is easily pumped against the steam pressure, thus indicating that if it had been correctly placed when the machine was assembled it would have remained there.

SPACE REPRESENTATION OF CENTRAL-STATION RATES.[1]

An Analytical and Graphical Study of Central-Station Rates and Their Representation in Space by Means of Points on Planes.

By Hugo E. Eisenmenger.

EVERY system of electric-service rates with very few exceptions is built up on only the two elements of the customer's energy consumption as measured by a watt-hour meter and of his maximum demand on the central station, either as measured by a demand meter or as defined by a limiting device or as represented by something more or less equivalent to the maximum demand, such as kilowatts connected, number of sockets connected, number of rooms, floor area, etc.

This means that for each definite system of rates the amount a of the customer's monthly (or yearly) bill is a function F of his energy consumption e and his maximum demand d.

$$a = F(d,e) \qquad (1)$$

The nature of the function depends entirely on the nature of the rates; in fact, the function *is* the respective rates system, mathematically expressed. The rates system is characterized by its equation (1), which shows the way for a graphical representation. As there are three variables a, d and e, use must be made of three dimensions and a solid rectangular system of co-ordinates. The geometrical representation will then be a surface in space. The surface represents equation (1) in the same way in which a curve in a plane represents an equation between two variables. Since the surface corresponds exactly to the equation, and the equation characterizes the rates system, the surface can also be used to characterize the system of rates.

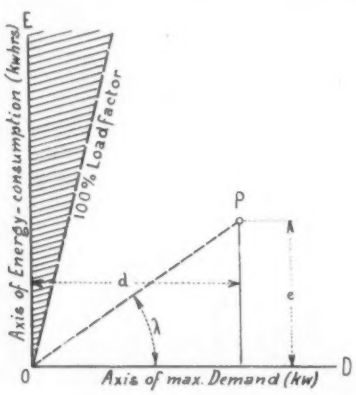
All lengths in the direction of the axis of e are measured in kw-hours, those in the direction of d in kilowatts (or rooms, square feet, number of sockets, etc.), whereas the scale in the vertical direction axis a is given in dollars (or cents). In the following the axes of d and e have been assumed as being horizontal, while the axis of a is vertical. The axis of d (kilowatt axis) is assumed to run from the contemplator toward the right side of the background, the axis of e (kw-hours) toward the left.

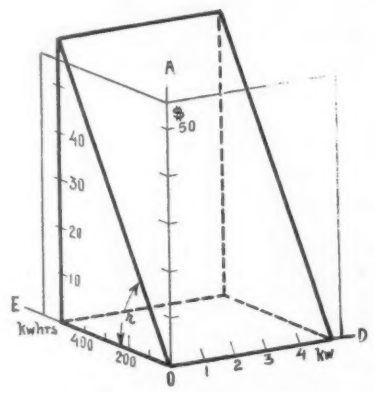
Taking only the two horizontal axes d and e into consideration, each individual customer is represented by a point on the horizontal bottom plane—his "characteristic point" P, Fig. 1. This point being connected with the origin of co-ordinates, the line OP will include an angle λ with the axis of demand OD, the tangent of which is proportional to $e \div d$, and therefore is proportional to this customer's load-factor.

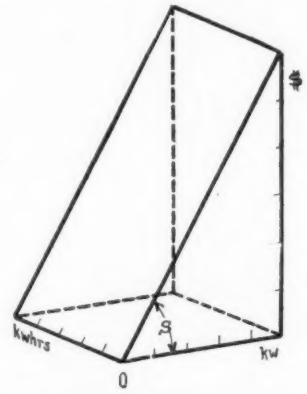
This angle has a certain maximum value which corresponds to the load-factor 100 per cent, or 730 hours' use per month. All points in the plane beyond the 100 per cent load-factor line (that is, in the shaded part of Fig. 1) have no equivalent in actual practice since their load-factor is larger than 100 per cent. From the above it is clear that all points on a line issuing from the origin O represent customers with the same load-factor.

Rising from the bottom plane into the third dimension, there is measured off upward from the characteristic point of every customer the amount of his bill under the system of rates being considered and the upper ends of all these verticals form the surface representing the rate system. The load-factor lines then change into vertical load-factor planes passing the origin of co-ordinates O and including the angle λ with the plane of co-ordinates ad. For every point on such a plane the load-factor represented by the value $e \div d$ is proportional to tan λ and is constant. Therefore a certain part of the surface will be cut off for practical purposes by the vertical 100 per cent load-factor plane. (This part has been painted black on the models, photographs of which are reproduced in the accompanying illustrations.)

In many cases it is possible to express the same system of rates by various schedules so that at first sight these various rate schedules seem to be different from each other, whereas they are inherently the same. The criterion whether two rate schedules are expressing the same rate system is that when they are reduced to mathematical functions these functions are the same in both cases and consequently the representing surface is also the same.







Figs. 1, 2 and 3—Space Representations of Amount of Variation of Bill with Energy and Power Charges.

Call the kw-hour charge z cents per kw-hour, then function F takes the shape

$$a = F(d,e) = ze \qquad (a \text{ in cents}) \qquad (2)$$

The straight meter rate is a special case since the bill is now independent of the maximum demand. The geometrical correlate is a plane passing through the axis of d and rising from the horizontal bottom plane of de at an angle the tangent of which is proportional to the kw-hour charge z.

A similar solid would represent the flat rate based on the kilowatts of maximum demand, except that this model would have to be turned around by 90 deg. with respect to the former.

The equation is $a = y.d \qquad (3)$

where y is the unit charge per kilowatt maximum demand (kilowatts connected, etc.) in cents and is proportional to tan S.

A combination of the straight kw-hour rate system and the kilowatt flat-rate system makes up the Hopkinson rate.

[1] The principles underlying the system of representation of rates which is described in this article were first published by the author as a contribution to the report of the rate research committee of the National Electric Light Association at the recent yearly convention of the latter in New York.

In the same way a combination of Figs. 2 and 3 represents the Hopkinson system (Fig. 4) with the charges represented by the tangents of the angles r and s

The equation is $a = yd + ze$ (4)

and this is an equation of the first degree representing a plane. Setting $d = 0$ we get the equation of the trace of the plane on the ae plane of co-ordinates $a = ze$; that means

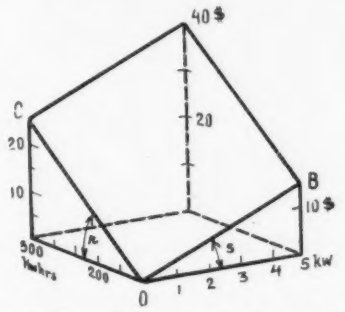


Fig. 4—Representation of Hopkinson System.

this trace rises at an angle from the axis of e, the tangent of which is z

$$\tan r = z$$

Similarly we get $\tan s = y$

One step further is the three-charge-rate system, or Doherty rate system, according to which each customer pays a certain constant amount per month which is independent of either his kilowatt-maximum demand or the kw-hours consumed. In addition he is charged an amount proportional to his maximum demand and another one proportional to his energy consumption. The customer's bill is then

$$a = x + dy + ez \quad (5)$$

where x, y and z are constants for each individual system of rates, x being the monthly customer charge in cents, y and z kilowatt charge and kw-hour charge as above.

This equation again is that of a plane; this time it is not a special case, but a plane in a general position in space (Fig. 5). Setting both d and $e = 0$, equation (5) reduces to $a = x$, which means that the plane intersects the axis of a at the distance x above the origin. From this it is seen that the customer charge x is geometrically represented by the vertical distance above the origin O, at which the plane of rates intersects the axis of a. The passing of the plane of rates through the origin O would mean that no customer charge is made, and, on the other hand, the higher the point of intersection between the plane of rates and the axis of a is located above O the larger the customer charge will be, whether it is explicitly expressed in the rate schedule or not.

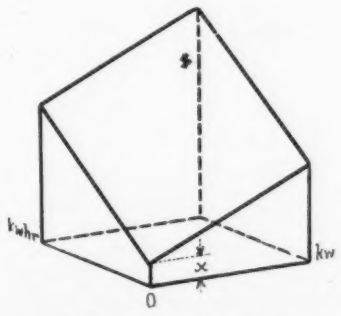


Fig. 5—General Representation of Plane in Space.

The demand and energy charges y and z are geometrically represented by the tangents of the angles which the traces of the plane include with the respective horizontal axes.

Leaving out for the present such rates as result in equations of higher than the first degree, and, therefore, in curved surfaces, it is seen from the above that the Doherty system is the general case, and the Hopkinson system, the flat-kilowatt rate and the straight-meter rate are only special cases.

There are, however, other special cases possible and widely applied; for instance, both kilowatt charge and kw-hour charge are zero and only the constant is charged.

This will take place in all such cases where a minimum charge applies; for instance, if it is stipulated that no bills are made out below $1 per month, all those customers who according to the rest of the rate schedule would be charged less than $1 will then be charged only by this

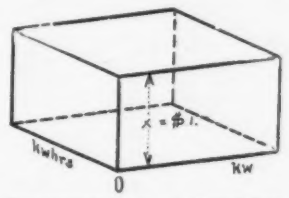


Fig. 6—Representation of Constant Charge.

minimum charge of $1 and neither kilowatt charges nor kw-hour charges will be made to them. The graphical representation, of course, is found (by setting the angles r and $s = 0$) as a horizontal plane at the distance x above the bottom plane (Fig. 6).

Another special case which occurs in the practice of rates can be found by setting only the demand charge y of the three-charge system equal zero (angle $s = 0$)

$$a = x + ze \quad (6)$$

This would mean a combination of a constant amount x with a kw-hour charge z (Fig. 7). The customer is charged, first, the constant of say $50 per month and, second, on top of this a charge of 3 cents per kw-hour.

It ought to be understood that this and similar kinds of rates are usually not given in this simple form in the schedules, but the form given by the schedules can be reduced into the above shape, as will be shown later. It is interesting to see that a great number of central stations (in fact, probably the majority of them) are using for certain classes of their customers a pure three-charge system without explicitly making the three charges. The three charges are, however, usually only implied, being concealed or disguised in one or the other way, as will be shown later.

Many central stations offer different rate schedules to the customer and leave the option to him on which one of these schedules he wants to be served. The customer, of course, will choose the schedule which gives him the lowest bill. This amounts to the same as if only one schedule applied to each separate point of the bottom plane and this schedule will always be the one represented by the lower plane.

A similar combination of schedules—whether optional or

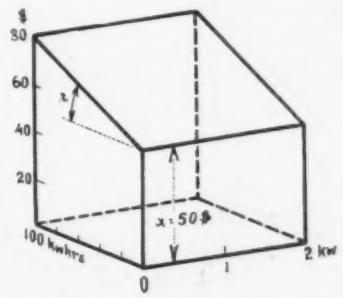


Fig. 7—Constant Amount Plus a Kw-hour Charge.

not—is in use in the majority of cases and the schedules used are almost universally of the three-charge system type—including its special cases, which result in setting one or two of the charges = 0. In many cases, however, the charges are not given in this simple way, but are concealed and disguised and can only be found by a simple mathematical analysis.

A very frequent way of expressing one or two of the three charges implicitly is by only giving kw-hour charges by the application of the multiple rate. A multiple-rate system is a rate system which stipulates a certain price p per kw-hour (the primary charge) until a certain kw-hour consumption of e_0 kw-hours is reached. For any consumption beyond this the kw-hour is charged at a lower rate s, the so-called secondary rate.

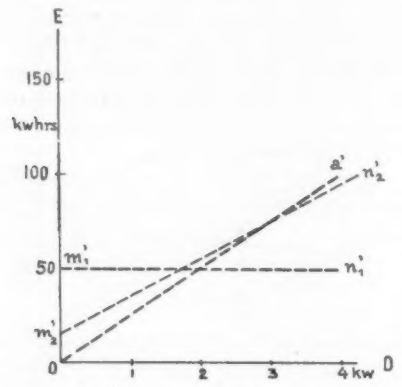


Fig. 8—Relation Between Power and Energy.

This energy consumption of e_0 kw-hours to which the primary charge is limited is a function of the customer's maximum demand:

$$e_0 = f(d) \qquad (7)$$

As long as a customer's energy consumption is smaller than $e_0 = f(d)$ he will be served by the primary charge on a straight meter rate

$$a = p.e \qquad (8)$$

After his energy consumption e has become larger than $f(d)$ his bill will be:

$$a = p.f(d) + [e - f(d)]\, s$$
$$= (p - s).f(d) + es \qquad (9)$$

In other words, if we draw in the de plane the curve representing $e = f(d)$ all customers between that line and the axis of d will be served on the straight meter rate of p cents per kw-hour, equation (8), and all the others will be served on a different rate, equation (9), the *character of this latter rate depending on the nature of the function* $f(d)$. We are having, therefore, *two different ranges* which are divided by the curve representing the equation $e = f(d)$ and this curve will, therefore, be called the "dividing line."

Theoretically, of course, $f(d)$ might be any function of the kilowatt demand, but in all practical cases only straight lines are employed as dividing lines. Function $f(d)$ then has the shape $f(d) = e_0 = md + n$, and we are getting two important special cases by setting first m and then $n = 0$. In the first case we get $f(d) = n$; that means the secondary charge applies after the consumption has reached a certain amount of n kw-hours independent of the kilowatt demand; for instance, 50 kw-hours. This would correspond to $m'_1 n'_1$ in Fig. 8, which shows again the de plane (bottom plane). Equation (9) then changes into

$$a = (p - s)\, n + es \qquad (9a)$$

Since p, s and n all are constants, the first term $(p - s)\, n$ of the right member also is a constant and the equation has the type of equation (6),

$$a = x + ze$$

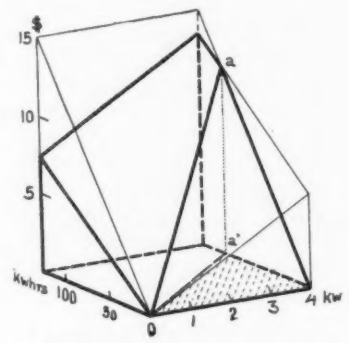


Fig. 10—Model of Multiple System.

where x is the fixed customer charge and z the kw-hour charge; no demand charge is made. This rate system expresses, therefore, in its secondary range a system of the type Fig. 7.

Fig. 9 is the model of a rate of that kind (primary charge $p = 12$ cents per kw-hour up to 50 kw-hours, after which the secondary charge of $s = 6$ cents applies) and shows from a geometrical point of view the same results as we found algebraically. If the secondary plane is parallel to the demand axis that means no demand charge is made ($y = 0$), and if produced backward beyond its range the secondary plane intersects the axis of a at the distance OA above the origin O, that means a constant customer charge OA is made where $OA = (p - s)\, n = (12 - 6)\, .50 = 300$ cents.

The second special case mentioned above (setting $n = 0$ in the equation $f(d) = md + n$) results in a straight line issuing from the origin O (Oa' in Fig. 8) and rising from the kilowatt axis at an angle the tangent of which is m. That means the secondary rate applies after a certain load-factor is reached or, in other words, after the maximum demand has been used for a certain number of hours per month. This is the famous Wright system.

The function $f(d) = md + n$ is reduced to $f(d) = md$ and equation (9) becomes

$$a - (p - s)\, md + es \qquad (9b)$$

p, s and m are constants and calling $(p - s)\, m = y$ and $s = z$, we get

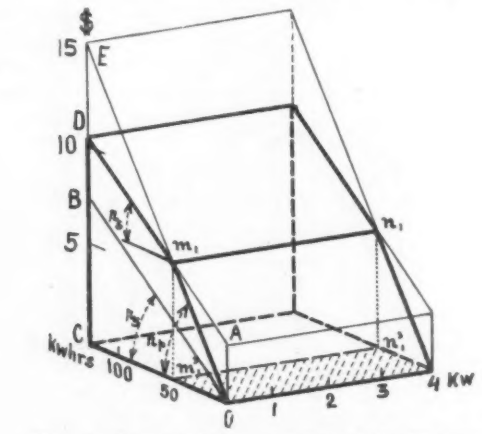


Fig. 9—Representation of Two-Rate Charge.

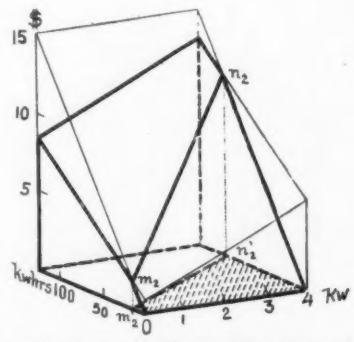


Fig. 11—Model of Three-Charge System.

$a = ya - ze$, which is identical with the equation (4) for the Hopkinson rate.

Fig. 10 is a model for a multiple system of this kind ($p = 12$ cents per kw-hour; $s = 6$ cents per kw-hour applying after twenty-five hours' monthly use of the maximum demand, Oa' in Fig. 8). This model shows that in the secondary range we are having a Hopkinson system

(compare Fig. 4) and also shows plainly where the Wright schedule and the Hopkinson say the same, viz., in the secondary range, and where and in what way they differ from each other.

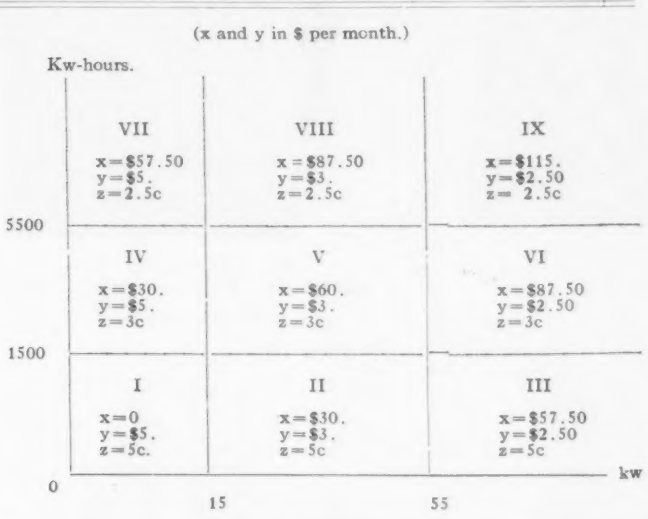


Fig. 12—Nine Ranges of Charges.

If a secondary charge is made after a certain constant number of kw-hours, the result is a constant customer charge for the secondary plane. If, on the other hand, the secondary charge is being made after a certain number of hours' use of the maximum demand, the result is a demand charge. It may be expected from this that by a combination of these two methods one can get a true three-charge system with both customer charge and demand charge, and this actually is the case. The secondary charge in this case is to be used after a number of kw-hours is reached which equals a certain number of hours' use of the maximum demand plus a constant number of kw-hours.

If $f(d) = md + n$, equation (9) changes into

$$a = (p - s)(md + n) + es \qquad (9c)$$
$$= (p - s)n + (p - s)md + es$$
$$= x + yd + ze$$

where
$x = (p - s)n =$ constant
$y = (p - s)m =$ constant
$z = s =$ constant

We see, therefore, a true three-charge system resulting. Fig. 11 represents a model for a system of rates of this type ($p = 12$ cents per kw-hour, $s = 6$ cents per kw-hour, $m =$ twenty hours, $n = 15$ kw-hours; that means the secondary charge applies after twenty hours' monthly use of maximum demand + 15 kw-hours is reached, $m'_2 n'_2$ in

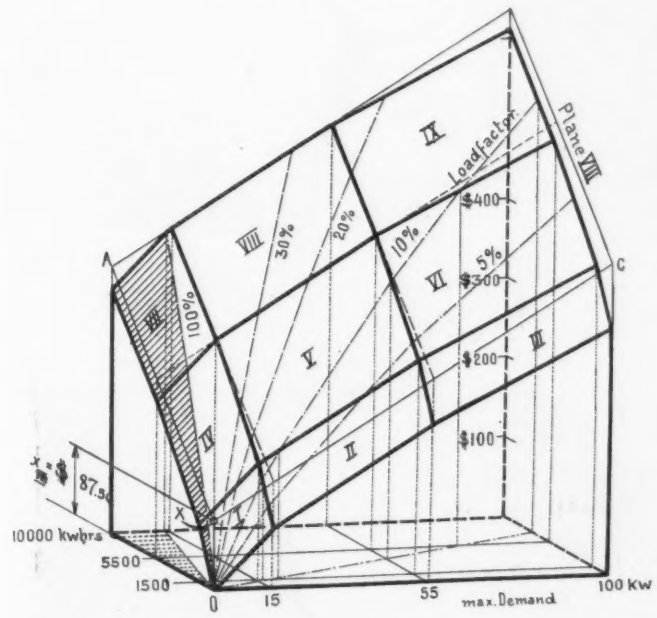


Fig. 13—Space Representation of Charges in Fig. 12.

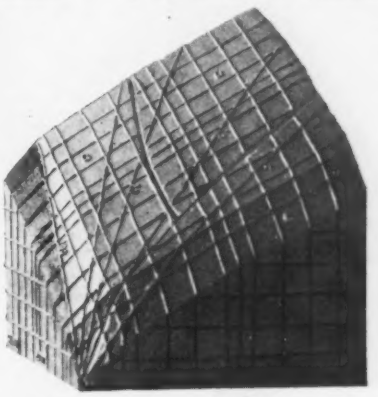


Fig. 14—Boston Lighting Rate.
100-kw simultaneous demand: 1000 kw-hours; $615.

Fig. 8. The shape of the model, Fig. 11, shows from the geometrical point of view that we now are getting a true three-charge system in the secondary range.

We get then
$x = (p - s)n = 90$ cents
$y = 120$ cents per kilowatt
$z = 6$ cents per kw-hour

Another method by which three-charge systems can be made without explicitly making all three charges is in use, for instance, in certain schedules of the rates in Boston and Chicago. The Boston rate, Schedule "C," for instance, says that 5 cents per kw-hour is charged up to 1500 kw-hours' use per month, 3 cents for each kw-hour between 1500 kw-hours and 5500 kw-hours and 2.5 cents for each kw-hour above 5500 kw-hours. Besides the following monthly demand charges are made:

$5.00 = 500c for each kilowatt below 15 kw
$3.00 = 300c for each kilowatt between 15 kw and 55 kw
$2.50 = 250c for each kilowatt above 55 kw

Another method by which three-charge systems can be made without explicitly making all three charges is in use, for instance, in certain schedules of the rates in Boston and Chicago. In Boston according to the so-called Schedule C rate 5 cents per kw-hour is charged up to 1500 kw-hours' use per month, 3 cents for each kw-hour between 1500 kw-hours and 5500 kw-hours, and 2.5 cents for each kw-hour above 5500. Besides the following monthly demand charges are also made: $5 for each kilowatt below 15 kw; $3 for each kilowatt between 15 kw and 55 kw; $2.50 for each kilowatt above 55 kw.

The bottom plane will, therefore, be subdivided into nine

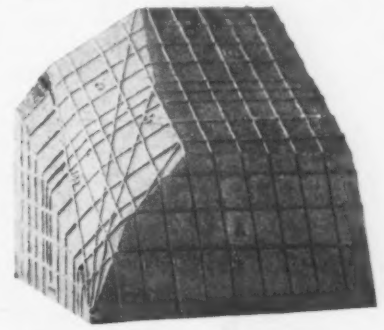


Fig. 15—Boston Lighting Rate.
100-kw simultaneous demand; 1000 kw-hours; $480.

different ranges, according to Fig. 12, and it must be expected that the function $F(d, e)$ representing the rate system is different for each one of these ranges. In range I (Fig. 12) there is, of course, an explicitly expressed Hopkinson rate, where $x = 0$, $y = 500$ and $z = 5$.

The charges for the other eight ranges are easily found,

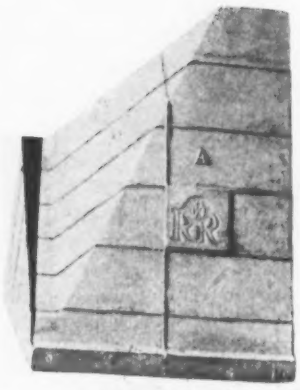


Fig. 16—Boston Lighting Rate.
2-kw simultaneous demand; 120 kw-hours; $13.20.

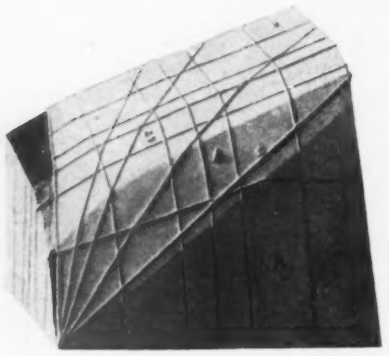


Fig. 17—Chicago Rate.
100-kw simultaneous demand; 10,000 kw-hours; $495.

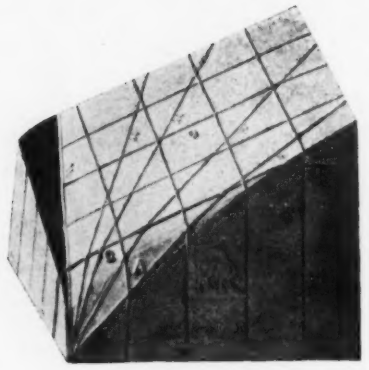


Fig. 18—Chicago Rate.
250-kw simultaneous demand; 25,000 kw-hours; $952.91.

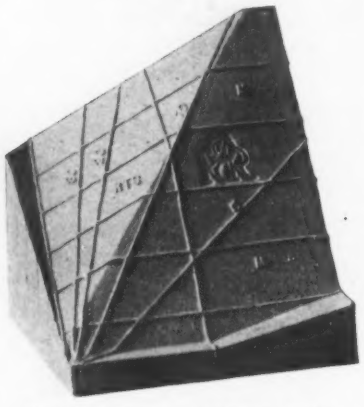


Fig. 19—Denver Lighting Rate.
40 connected 16-cp lamps = 2 kw; 120 kw-hours; $10.80.

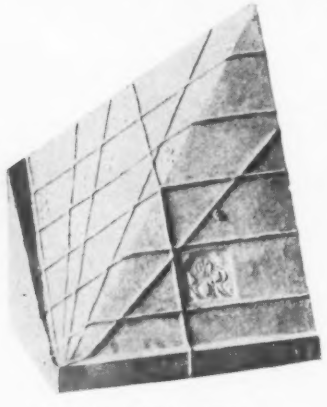


Fig. 20—Lowell Rate.
2-kw connected load; 120 kw-hours; $12.78.

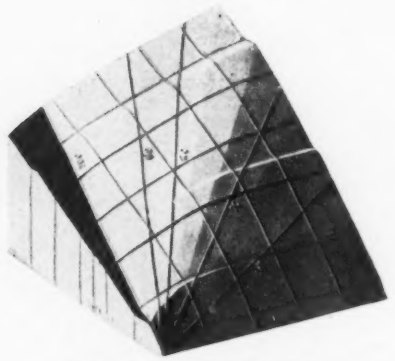


Fig. 21—New York Rate.
100-kw connected load; 10,000 kw-hours; $891.00.

Fig. 22—New York Rate.
2-kw connected load; 120 kw-hours; $12.00.

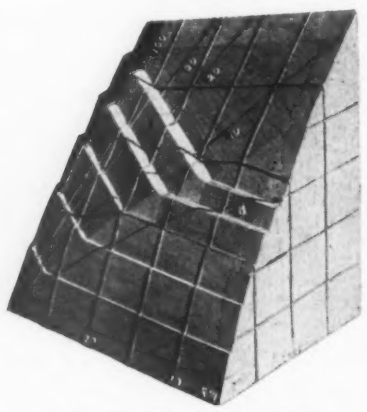


Fig. 23—Minneapolis Rate.
50-kw simultaneous demand; 4000 kw-hours; $228.50.

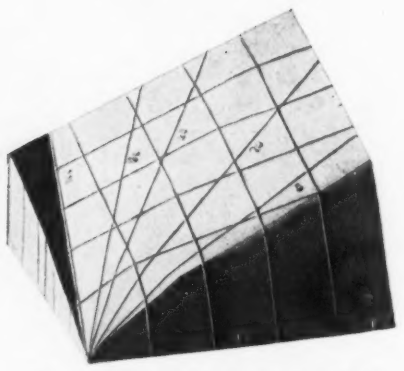


Fig. 24—Boston Motor-Service Rate.
100-kw simultaneous demand; 10,000 kw-hours; $373.63.

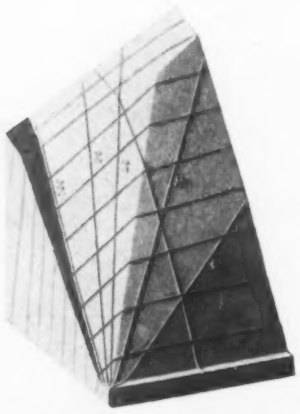


Fig. 25—Boston Motor-Service Rate.
2-kw simultaneous demand; 200 kw-hours; $16.68.

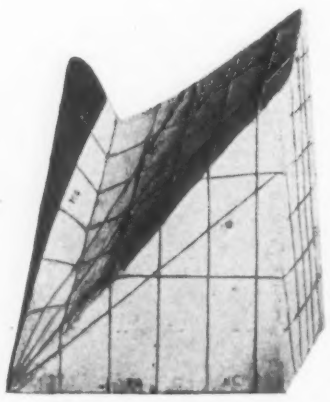


Fig. 26—Baltimore Rate.
110-kw simultaneous demand; 12,000 kw-hours; $680.00.

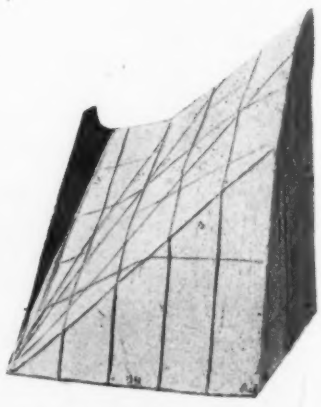


Fig. 27—Wilmington Rate.
250-kw simultaneous demand; assumption: 1 kw corresponds to 320 cp; 25,000 kw-hours; $1,293.71.

as will be shown in the following by the example of range VIII—that is, a customer with a maximum demand between 15 kw and 55 kw and an energy consumption of more than 5500 kw-hours.

The customer has to pay 5 cents for each one of the first 1500 kw-hours, 3 cents for each kw-hour between 1500 and 5500, and finally 2.5 cents for each kw-hour beyond the first 5500 kw-hours. Moreover, the customer's demand is charged 500 cents for the first 15 kw and 300 cents for the rest, the assumption being, as explained above, that his demand is larger than 15 kw and smaller than 55 kw.

The total monthly bill is therefore, in cents,

$$a = 1500 \times 5 + 4000 \times 3 + (e - 5500)\,2.5 + 15 \times 500 + (d - 15)\,300$$
$$= 8750 + 300\,d + 2.5\,e$$

The rate in this range, therefore, is equivalent to a full three-charge system with a customer charge of $x = 8750$ cents = $87.50 per month; a demand charge $y = 300$ cents = $3 per kilowatt per month; an energy charge $z = 2.5$ cents per kw-hour.

In the same way the charges have been determined for all ranges and the results have been recorded in Fig. 12. It can be seen from this that the customer charges can be quite considerable and are much higher than is usually assumed, running in this particular case up to $115 a month. Customer charges of about the same order are also implied in the schedules for large customers in other cities, although they are not always explicitly expressed.

After the three charges for each range are found the corresponding planes can be constructed without difficulty, the intersection of each plane with its neighbor being, of course, directly above the 1500 kw-hour or 5500 kw-hour line or the 15-kw or 55-kw line respectively. Fig. 13 is an outline drawing of the solid representing this rate system giving at the same time the plane of the range VIII produced ($ABCX$) in order to show the geometrical meaning of the above algebraical deduction. The height OX is the customer charge of $87.50. Fig. 14 is a photograph of the model of the above schedule.[2]

In addition to Schedule C there are two optional schedules in Boston, called Schedule A and Schedule D_1, which are described below; these will cut off parts of the surface of the solid shown in Fig. 14. Schedule A is a straight-meter rate of 11 cents per kw-hour and Schedule D_1 charges $2,160 per year for each customer ($180 per month) as fixed charge and besides 3 cents per kw-hour. D_1 is therefore a three-charge system with demand charge $y = 0$ and both remaining charges explicitly made in the schedule. The equation is $a = 18{,}000 + 3\,e$ (in cents) and of Schedule A $a = 11\,e$.

Wherever these planes are lower than the nine planes referred to above they cut off a corresponding piece of the solid, the resulting composite block being as shown in Fig. 15, which represents a model of the combination of Schedules A, C and D_1, and gives the lowest one of the three-rate schedules for each respective customer.

Fig. 16 is the part of the model of Fig. 15 near the origin of co-ordinates built on a greatly enlarged scale in order to show two additional features which cannot be expressed in the smaller scale. The first one is a minimum charge of $1 per month, which results in the step at the lower edge of the model, and the other one is a stipulation in Schedule C that the demand shall in no case be taken into calculation at less than 0.2 kw. Therefore, for all such customers whose demand is smaller than 200 watts the equation $a = yd + ze$ in range I becomes

$$a = y \times 0.2 + ze$$
$$= 500 \times 0.2 + 5\,e = 100 + 5\,e,$$

which results in the inclined step at the left side of Fig. 16.

The Chicago rates, which are represented in Figs. 17 and 18 in two different scales, are composed in a similar way of (1) a Schedule C on the same principles as in Schedule C in Boston, but with different numerical values and (2) an optional Schedule A, which is a Wright schedule, and, therefore is represented by two planes.[3] The model shows that schedule A is the more advantageous one for short-hour users.

Fig. 19, the Denver lighting rate, consists of a straight meter rate, Plane M, and an alternative three-charge system called "readiness to serve," Plane RTS, involving a customer charge of $9 per customer per year plus a "demand charge" of $1.80 per year per 16 cp connected and 5 cents per kw-hour. All bills are subject to 10 per cent discount for prompt payment.[4]

The meter rate and the "readiness-to-serve rate" again combine into one solid. As a reverse operation of the resolution of a multiple system into two different rates as shown, the Denver rates might also be reduced into one multiple-rate system without changing anything else but the form of expressing the rates. The bill of each customer, the total income of the central station and the model would not be affected by such a change. The minimum charge is 5 cents per month per lamp installed and not less than $1 per month. This results in the peculiarly shaped step at the bottom of Fig. 19.

An interesting rate system is in use in New York,[5] as represented in Figs. 21 and 22. This is a multiple-rate system, but with more than two gradations. There is a primary charge of 10 cents per kw-hour for the first thirty hours' monthly use of connected load; a secondary charge of 9 cents for the next thirty hours; a tertiary charge of 8 cents for the next thirty hours; a quaternary charge of 6 cents for the next thirty hours; a quintenary charge of 5 cents for the next 300 hours and a sextenary charge of 5 cents for the excess above 420 hours. This is, therefore, as it were, an extension of the Wright schedule. This results in six planes all meeting at the origin O, and each one tilted at a smaller angle toward the horizontal than its predecessor, so that a series of triangles results somewhat like a fan bent into a curved surface. Furthermore, there is a reduction of 5 per cent to be made of the total bill if the aggregate of energy used averages 5000 kw-hours monthly and 10 per cent if 10,000 kw-hours is exceeded. Therefore, the height of all planes has to be lowered by 5 per cent between 5000 kw-hours and 10,000 kw-hours, and by 10 per cent above the 10,000 kw-hour line. This would result in a sudden drop of the amount of the bill as the customer's energy consumption rises, for instance, above the 5000 kw-hour line, and all customers using between 4750 kw-hours and 4999 kw-hours would have to pay more than if their energy consumption had reached 5000 kw-hours. To avoid this no bill is issued to a customer for a consumption of less than 5000 kw-hours at a cost greater than it would have been had the energy used actually amounted to 5000 kw-hours at unchanged connected load. This means that in the model the saw-tooth humps resulting from the sudden drop of the amount of the bill have to be smoothed out in the following way: Draw horizontal lines parallel to the kw-hour axis through every point of the line of intersection of the discounted surface (5 per cent) with the 5000 kw-hour plane; in other words, through every point of the lowest edge of the 5 per cent discounted surface. The locus of all these hori-

[2] As the models of which the accompanying photographs were taken had necessarily to be made in various scales, the scale is indicated at the foot of each cut by giving the number of kilowatts which corresponds to the length, the number of kw-hours corresponding to the width and the number of dollars represented by the height of the model at its highest point.

[3] As regards numerical values, for all models throughout have been chosen the net amounts of the bills after all cash or other discounts are given.

[4] The demand charge in this case is, therefore, not based on the maximum demand, but on the candle-power connected and the scale of the axis d should, therefore, be expressed in candle-power as unit. In order, however, to bring this model to approximately the same basis as the rest it has been assumed in a more or less arbitrary way that twenty 16-cp lamps correspond to 1 kw (connected), so that the scale is given also in this case with the kilowatt as the unit.

[5] This system has been superseded recently by another schedule.

zontal lines forms six planes parallel to the kw-hour axis and the change from the undiscounted to the discounted surface has to be made on these planes, as shown in the photograph. The same thing, of course, applies to the 10,000 kw-hour line. A minimum charge is made under this schedule, but it is not a fixed amount, but based on a certain minimum amount of kw-hours (2000). One must draw the intersection of the surface with the 2000-kw-hour plane and through this intersection line pass planes parallel to the kw-hour axis in the same way as described above. These planes will then determine the minimum charge. A large part of the range of this minimum charge, however, is cut off by another schedule, a straight 10-cent meter rate, as shown in the model.

The equations of the planes are easily found:

Primary $a = 10\,c$.

Secondary $a = 10 \times 30\,d + (e - 30\,d)\,9 = 30\,d + 9\,e$.

Tertiary $a = 10 \times 30\,d + 9 \times 30\,d + 8\,(e - 60\,d)$. $= 90\,d + 8\,e$.

Quatenary $a = 10 \times 30\,d + 9 \times 30\,d + 8 \times 30\,d + 6\,(e - 90\,d) = 270\,d + 6\,e$.

Similarly:

Quintenary $390\,d + 5\,e$.

Sextenary $600\,d + 7.5\,e$.

All planes after the primary are Hopkinson planes.

A similar gradation by quantity discounts is shown in the Minneapolis model, Fig. 23. The basis of this system is a pure Wright schedule with a dividing line of fifty-two hours' monthly use. Two different kinds of discounts are granted. One is a quantity discount varying by steps of 5 per cent between 0 per cent and 25 per cent, which in this rate is made after the bill has reached a certain amount and not as in New York after a certain number of kw-hours is reached. This means that the lines along which the discounts are changing from one percentage to the next are the intersections with horizontal planes instead of with constant kw-hour planes (vertical) as in New York. The humps are smoothed out in exactly the same way as described above. After this a cash discount is allowed on bills paid within a certain time. This discount, however, is not a certain percentage, but 4 cents per kw-hour on the primary rate of 14 cents and 1 cent per kw-hour on the secondary of 7 cents. The cash discount, therefore, is a smaller percentage for customers whose bill is constituted in great part of the secondary charge—that is, for long-hour users. The larger the load-factor of a customer who gets the benefit of the secondary rate the smaller his cash discount will be in per cent. Since in this model, as in all others, the net bills have been reproduced, the lines along which the quantity discounts are changing are, therefore, not horizontal in the secondary range, but they rise with rising load-factors, whereas the same lines in the primary range remain horizontal.

The Boston motor-service rates, Schedule B, are shown in two different scales in Figs. 24 and 25. This schedule is as follows:

A price of 12 cents per kw-hour is charged for all electricity furnished, with five different deductions which apply partly after certain load-factors and partly after certain amounts of monthly bills are reached. The fifth deduction reduces the average price per kw-hour to 11 cents whenever the average price, after the foregoing deductions have been made, exceeds 11 cents, but in no case shall the monthly bill be less than $1. By expressing this schedule in form of equations $a = F\,(d, e)$ there are obtained nine different planes.

Here as in all previous cases the lines of mutual intersection of the planes in space (including the traces on the planes of co-ordinates) can be found by application of the rules of elementary analytic geometry and descriptive geometry. By projecting the lines of intersection on the horizontal plane of de there are obtained the dividing lines between the ranges of the different planes, both graphically, as the result of descriptive geometrical methods, and by their equations, as the result of the application of analytic geometry.

Fig. 26 illustrates an interesting system of rates; the Baltimore schedule, which is represented not by planes but by curved surfaces (hyperbolic paraboloids). This rate system is a Wright schedule (primary 10 cents per kw-hour up to fifty hours' use, secondary 5 cents, 5 per cent cash discount) with the additional feature that beginning from a demand of 3.75 kw certain deductions are made from the secondary charge as the maximum demand increases. The secondary charge of originally 5 cents per kw-hour diminishes 0.1 cent for every 0.75 kw of maximum demand between 3.75 kw and 18.75 kw, so that it reaches 3 cents at 18.75 kw. Between 18.75 kw and 93.75 kw a diminution of 0.1 cent takes place only for every 7.5 kw and beyond this for every 56.25 kw. This results in three different paraboloids, the ranges of which are divided from each other by the 18.75-kw and 93.75-kw lines (parallel to the axis of e).

As can be seen from Fig. 26 in the range of the first paraboloid (3.75 kw to 18.75 kw) the surface forms a peculiarly shaped horn. This horn is the result of the fact that the secondary charge decreases much more rapidly between 3.75 kw and 18.75 kw than in the range beyond 18.75 kw. A similar horn would show in the ranges of the other paraboloids if the model was extended far enough into the large energy consumptions. These horns are, however, of little practical importance, since they are not only cut off to a large extent by the 100 per cent load-factor, but they also apply to very large load-factors only and customers with very large load-factors are served on another schedule, the industrial schedule.

Since, as stated above, the secondary charge is a variable only for demands above 3.75 kw, for demands below this amount (residences, etc.) there is a pure Wright schedule. According to a further stipulation the secondary charge does not apply at all if the use of energy does not exceed a minimum total of 50 kw-hours. By imagining the shape of the model it can be easily seen that this is only another wording for what was found already in the Boston retail rates (Fig. 16), namely, that no demand shall be taken into consideration at less than a certain minimum; this minimum in Baltimore is 1.11 kw. As the Baltimore rates also provide a minimum charge per customer ($1) the retail model will be of exactly the same type as Fig. 16

Even in those rare cases where, as in Baltimore, the surfaces of the models are not planes but curved surfaces, there will always exist an equivalent three-charge rate which can be found by passing a tangential plane through the point under consideration on the surface. This plane will indicate the three charges by its position in space. In this case, therefore, the three charges will vary gradually from one point on the surface to the next (that is, from one type of customer to the next), whereas in the majority of cases (where the surfaces are planes) the three charges are constants for a certain range and then change abruptly.

The above discussion of a number of representative rate systems does not, of course, in any way claim to embrace all the rate systems in use. It will be found, however, that the vast majority of all rates can be reduced to the same elements as the examples dealt with above, such as multiple rates, graduated unit prices, quantity discounts, minimum charges of various descriptions, etc., and it is then an easy matter to get a clear idea of the character of a certain type of rate by means of representing it by a model.

A geometrical and algebraical analysis of a certain system of rates along the lines indicated in this article may also show how to avoid an unnecessary complication in making the schedule to express a certain desired system of rates.

LETTERS ON PRACTICAL SUBJECTS

PHOSPHOR-BRONZE ARMATURE BINDING WIRE.

The accompanying table giving the properties of phosphor-bronze wire as used for binding wire on armatures may be useful to some readers of these pages.

Number.	Diameter, Inches.	Elongation in 8 In., per Cent.	Elastic Limit, Pounds per Square Inch.	Tensile Strength Pounds per Square Inch.
20	0.032	0.30	95,000	130,000
17	0.045	0.40	90,000	130,000
15	0.057	0.50	80,000	130,000
14	0.064	0.50	80,000	125,000
13	0.072	0.60	80,000	125,000
10	0.102	0.75	80,000	125,000

Kenyon, R. I. H. M. NICHOLS.

COMPARATIVE FLOOR SPACE OCCUPIED BY ENGINES AND TURBINES.

A certain electric light and power station was formerly supplied with power by four tandem compound condensing engines, belted to one long shaft, from which power was taken to drive several generators, as shown in Fig. 1. The space occupied by this machinery was 62 ft. long.

The use of these engines was discontinued and one steam turbine installed, which furnished an equal amount of

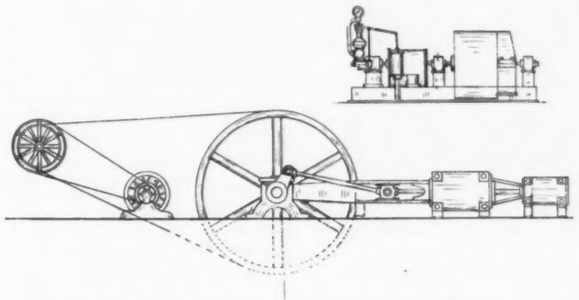


Fig. 1—Side View of Belted Units and Turbine.

power. This is shown above the engine in Fig. 1, and as they are both drawn to the same scale the comparative space is at once apparent, as only 22 ft. are required by the turbine.

Fig. 2 is an end view of the same machines, showing four engines each 10 ft. wide, exclusive of the space between them, while the turbine is only 4½ ft. wide. As these are drawn to the same scale, the differences in space required can be seen at a glance, thus giving a graphic representation of the great improvement made in this

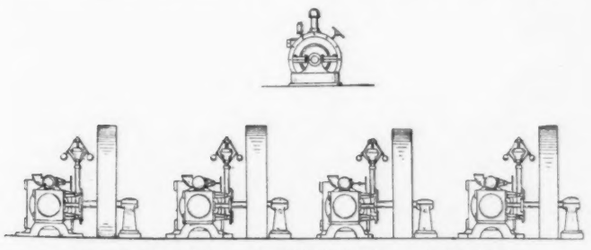


Fig. 2—End View of Belted Units and Turbine.

respect by introducing one turbine to displace four engines.

One day this turbine broke down and the internal parts were shipped by express to the manufacturers for repairs. They were returned in two months. A comparative break in one of the engines would have disabled one-quarter of this plant for two or three days. This illustrates a phase of the subject that is not always included in description of such plants.

New Haven, Conn. W. H. WAKEMAN.

USE OF IRON PIPE IN PLACE OF CONDUIT.

In so far as the writer has been able to ascertain electrical conduit is merely commercial wrought-iron pipe of standard weight that has been carefully reamed inside to remove burrs and then treated with zinc, or an enamel baked on, to prevent rust. The threads on the ends of conduit lengths are standard pipe threads. Hence, where underwriters' inspectors do not have jurisdiction iron pipe can be used instead of conduit. The pipe is cheaper, and in dry locations it appears to serve as well as conduit. A coat of black stove-pipe enamel on the outside of the pipe will give it a finished appearance, and more than a superficial inspection is required to distinguish a pipe so treated from conduit. It is the practice in some industrial plants where the buildings are all of fireproof construction and where no insurance is carried to use galvanized-iron pipe instead of conduit.

Dayton, Ohio. G. M. KELLER.

GENERATOR AND MOTOR BELTS.

The providing of serviceable and economical motor and generator belts is a problem which has vexed many a designing engineer and station manager. The rubber belt is not to be considered for this service. Rubber has become too scarce and costly to be considered in the same breath with transmission belting, and belts made with many of the so-called "rubber substitutes" will be considered by the same purchaser but once after he buys them, and that consideration is how to get rid of them without loss of first cost or delay to the plant. Good leather belting, honestly made from well-tanned hides, leaves nothing to be desired in the way of belting for almost any purpose; but genuine leather belting, cut from the backs of bullocks, is too much like turtle soup—for every genuine one there are ten imitations.

The only way to procure a leather belt which is strictly short lap, from the backs of hides, and which has been properly tanned and which measures not less than 3/16-in. in thickness and weighs not less than 32 oz. to the square foot of single thickness, is to inspect everything from the time the hides are dehaired until the belt is delivered. The tanner has methods of profit whereby he can hasten the tanning process, and the currier has other methods of great interest to him, as thereby he can take thin, light hides which will not pass the thickness and weight specifications and by stuffing these hides with fish oil and other substances he soon causes the light hides to thicken past the limit and to weigh 16 oz. to the pound when he gets through with them. And on top of all that there is a way of cutting the sides and belly of the hide into short-lap pieces for belts which, when sold at regular short-lap prices, prove most profitable. Belts thus made cause power to be lost through uneven running, for steady power cannot possibly be transmitted through belts which have stretched on the edges until they are swaying from side to side and threaten to run entirely off the edges of the pulleys every time the belt-length comes around.

The writer has been through this belt business and has come to the conclusion that the leather belt can be dispensed with altogether and impregnated stitched cotton belts substituted for the leather, with satisfactory results, in every case likely to come up in general engineering practice. The writer some time since specified these belts for a factory which was driven by a 15-hp induction motor with a 6-in. by 6-in. pulley. In this factory there was a pressure

blower, driven by two 3-in. belts running over 4-in. by 3-in. pulleys on the blower-shaft. All three of these belts have been in continual use for several months, have given no trouble at all and are apparently in just as good condition as the day they were installed.

It will not do, however, to select any piece of this belting which comes to hand, put it on the pulleys and expect it to give good service. In place of haphazard methods the belt must be carefully selected and put through certain tests before acceptance. A good method of testing this kind of belting is to lift a crosswise yarn, unravel it and count the number of threads. In the best belting these threads are seven in number. Another yarn should then be taken out of the lengthwise weave and its threads counted also. These threads should equal in number those in the other yarn. When this is the case the weave is said to be equalized and the best possible combination has been made in both warp and filling. Next, make a knife cut exactly 3 in. from the end of the belt. It is not necessary that 3 in. be taken for the distance of the cut, but this is a convenient distance and is taken for the reason that many of the belt samples are cut 3 in. in length, hence it is possible to test out samples by taking that length of cut. Carefully remove a length of the yarn from the warp, and it may be noted that it is wavy or crinkly, on account of the weave. It is the straightening of these kinks which gives the stretch that is sometimes troublesome in this class of belt, but when the directions given hereinafter are followed there will be no trouble from undue stretching. Straighten the bit of yarn by pulling it between the fingers, taking care that none of the twist is taken out of the yarn. If some of the twist is lost, put it back again, for the yarn must not be unduly lengthened by untwisting it. After the crinkle has all been taken out measure the length of the yarn again and note the increase caused by rubbing out the waves or crinkles. The elongation should not be much greater or less than 25 per cent in any belt which is accepted. When the elongation is more than 25 per cent the belt is so slackly woven that it will stretch unduly, and when the elongation is less than the stated amount the belt is too tightly woven and the pull upon the threads will result in cutting or breaking them before the belt has worn out otherwise.

There is another point which must be strictly looked after if good service is to be obtained from this type of belting. The transmission should be designed and the diameters and faces of pulleys chosen so that together with the necessary belt speeds the belt will in no case be subjected to a working pull or strain of more than 40 lb. to the inch of width. A belt thus designed and proportioned will wear long and give little trouble. Belts of this material may be put together in a variety of ways. They may be laced, but a hinge lacing is preferable. A good way to join this kind of belt is by means of "Bristol" belt hooks. This fastening is a wrought-steel plate with rows of teeth turned up at either end, the teeth being driven through the belt and clinched on the pulley side. The fastenings hold well and when the belt is taken up or shortened it is necessary to cut out only 1 in. of belt, that being the length taken up by the fastening in question.

The best belts of this material are filled with linseed oil or with a preparation of paraffin. Either filling suffices, but the paraffin filling is the more pliable and the writer believes the belt lasts longer than the belt filled with paint oil. Still, either kind is good, and if selected as directed will save more than two-thirds of belt bills.

Scranton, Pa. JAMES SCOTT.

FILING ENGINEERING CLIPPINGS.

I was interested in the description in the first issue of October (page 887) by Mr. H. M. Nichols of his envelope system for filing clippings. I use a similar system which I have further improved by using translucent envelopes which save writing, as the headings given the article by the author can be readily seen and the clipping can at once be placed in the file in alphabetical order. Each clipping is by itself and protected from injury, and can easily be handled and rearranged according to the place desired in one's studies. Some of the envelopes are of the size of an index card, and there are several larger sizes up to the size of a magazine page. I have called them "Kwiktofile" and "Kwiktofind."

Penn Yan, N. Y. EDWARD R. TAYLOR.

A METHOD OF MAKING UP A GROUND WIRE.

Where a ground wire is to be connected to a pipe and no ground clamp is available the method herein described and illustrated can be used. A length, possibly 3 ft., of the ground conductor is "skinned" and carefully scraped or cleaned with fine sandpaper. The pipe on which the connection is to be made is filed bright and clean for a distance of several inches and "tinned" if the connection is to be soldered. Then the bared end of the conductor is arranged, on the brightened portion of the ground pipe, as indicated

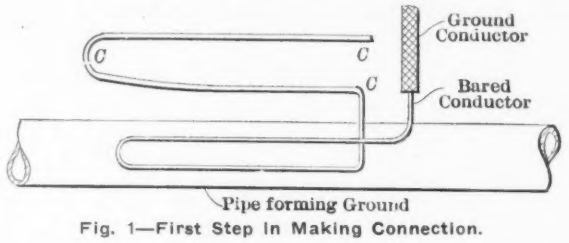


Fig. 1—First Step in Making Connection.

in Fig. 1. The free end of the wire (*c, c, c*, Fig. 1) is then served around the pipe as suggested in Fig. 2, and the free end, *c*, of the wire is passed through the loop *B*. The end *A* is then pulled. This draws the loop *B* and the end *c* up tightly against the other turns and effectively prevents the wrapping from unwinding.

In an actual connection the turns on the pipe are wound closely together. They are shown separated in Fig. 2 better to illustrate the method. The connection can be soldered with a blow torch and wire solder using a paste flux or by pouring molten solder over the connection until it is hot enough for the solder to adhere. The soldering pot should be held under the connection during the pouring to catch the solder as it drops from the connection.

Where soldering is not feasible the connection can be

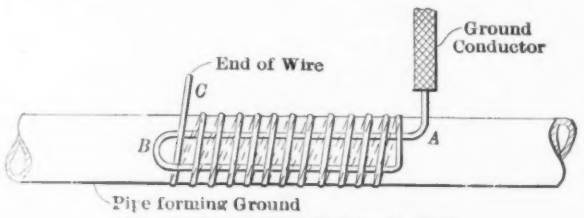


Fig. 2—Connection Ready to Pull.

wrapped with a couple of layers of tinfoil and then with several layers of friction tape. These layers exclude moisture and prevent oxidization. One of the large telephone companies has used the tinfoil and tape method on many hundreds of ground connections for telephone subscribers' stations with excellent results. The tinfoil and tape should extend along the pipe for several inches on each side of the connection and should be wrapped firmly so that they will form a moisture-proof jacket.

Bridgeport, Conn. GEORGE L. EDGAR.

SOLDERING WITH BLOW TORCH AND IRON.

When soldering connection between wires smaller than No. 8 many wiremen use a blow torch for heating the joint. While a joint can be made in this way, the writer

has found it much better to use a soldering copper where small wires are involved. Where a blow torch is used the insulation on the conductors is nearly always ignited and burns with a thick smoke and blackens any object on which it deposits. If the work is being done near a clean ceiling or side wall the result is a sooty spot near the point where each joint is made. It is probable also that the excessive heat of the blow torch injures the adjacent insulation on the conductors. Furthermore, the blow torch is difficult to manipulate in restricted locations. A small alcohol torch is sometimes used instead of a blow torch and is better adapted for the work, but it is probably not as good as a soldering iron.

In using a soldering copper it is heated in the flame of a blow torch. To solder the joint the hot tool is placed under and in close contact with it and wire solder is fed into the turns of the joint. After the solder has flowed over the entire surface of the joint the iron is removed and the joint is shaken to throw off surplus solder. There is no ignition of insulation and no sooty smoke where a joint is soldered in this way. The soldering copper can be used in confined spaces where the use of a torch would be out of the question. It is understood that the wires to be soldered must be scraped clean and bright before the tool is applied. Any of the commercial soldering pastes will probably be found convenient as a flux.

Toledo, Ohio. CARL JENNINGS.

HOME-MADE DEVICES USED IN ENLARGING STATION.

Extensive enlargements and improvements now in process at the Colfax Avenue (South Bend, Ind.) station of the Indiana & Michigan Electric Company, which have been vigorously prosecuted for over two years, are seemingly unable to keep pace with the increasing business of that company and the new turbine station, recently completed as described in these columns at various times, is now undergoing enlargement in the boiler house. Four steel stacks are to be removed and two reinforced concrete stacks, 220 ft. high with a flue diameter of 11 ft., are being erected and one has already, as shown by Fig. 2, reached a height of 180 ft.

Fig. 1 shows the manner in which a stack was commenced, two sections of mold being visible above ground with another section just in sight below the ground line. The method by which the reinforcing is centered and held in place is shown by the upper stage above the stack. Fig. 2 shows the other stack, which had reached an elevation of about 160 ft. at the time the photograph was taken, with 55 ft. more to go. In the foreground of this half-tone may be seen the sheet piling along the excavation for the water tunnel. The rail beside the excavation is for a traveler of 20-ft. gage which carries a stiff-legged crane, which in turn is fitted with a bull-wheel, movable boom and which is actuated by a three-drum hoisting engine. This traveler is described later.

The manner of mixing and hoisting concrete for the stack and for the large amount of underground work round the base of the stacks calls for several mixers of the most improved types. Fig. 3 shows an electrically driven cube mixer of large capacity, equipped with a power loader which takes material direct from barrows, a hole having been excavated in the ground to permit the loader to go down very low so that barrows may be dumped directly into the loader. The mixer is arranged to discharge into small steel cars, which are pushed over light tracks to the point where concrete is required. This half-tone also shows the base of the higher stack and the fine appearance of the concrete composing this stack is plainly visible. The writer has never seen a cleaner or better appearing bit of concrete work, which is made from Indiana gravel and good, clean sand.

Hoisting material to the top of the stack is effected by a very ingenious and simple piece of apparatus shown by Fig. 4. This rig is so simple that the writer is almost ashamed to describe it, but at the same time the device is a masterpiece of true engineering and of making good with the simplest articles. The winding drum is an old affair

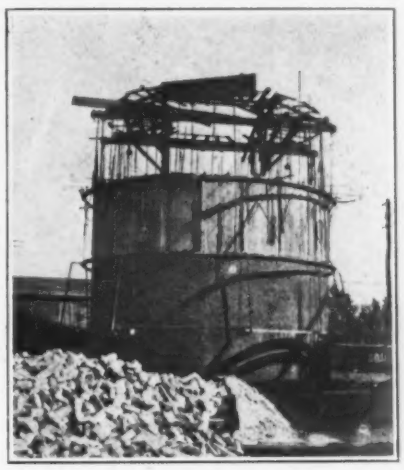


Fig. 1—Beginning of Stack.

taken from some contractor's wall derrick. Being hollow, a piece of steam pipe was thrust through it for a shaft and the drum turns loose upon the pipe shaft, which is housed in slots cut in pieces of 2-in. planking, which form the frame of the little machine. A 24-in. pulley, bolted to one head of the drum, receives a 6-in. rubber belt from a 6-in. pulley placed on a short shaft located on a couple of blocks which in turn rest directly upon the ground or upon another pair of short blocks. Another 24-in. pulley upon the lower shaft receives power from a small three-phase motor conveniently located in a rain-proof box near by.

A simple plank lever, fully shown by the half-tone, is located upon the upper shaft. When it is desired to hoist a load of concrete the handle of the plank lever is de-

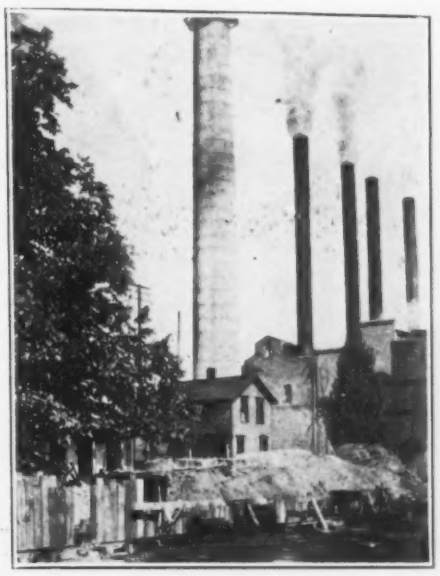


Fig. 2—Concrete Stack.

pressed. This raises the shaft and tightens the short rubber belt, causing the drum to wind upon it the hoisting cable. When the load of concrete has arrived at the top of the chimney the plank lever is raised and this lowers the shaft, loosens the belt and the drum ceases to wind on more of the cable. But this is not all that the machine does.

Between the folds of the belt, directly below the pulley, there is a segment of planks nailed together and fitted to the circumference of the pulley. When the end of the plank lever is raised the shaft is lowered and the belt loses power, as stated, but when the lever is raised still farther the face of the 24-in. by 6-in. pulley is brought into contact with the segment which acts as a brake and holds the load securely at any point. The entire amount of material used in one of these large stacks was hoisted by means of this simple home-made machine, which seems capable of hoisting material for another stack without repairs or renewals of any of its home-made parts. In fact, the entire series of operations in connection with the improvement of the Colfax Avenue station seems to have been carried on by the use of the simplest material. The derricks employed in the excavating work are built up from telegraph poles and common timber shapes which will be available for their usual purposes after the construction work is finished. Resourcefulness is shown in the economical make-up of the necessary machine and appliances.

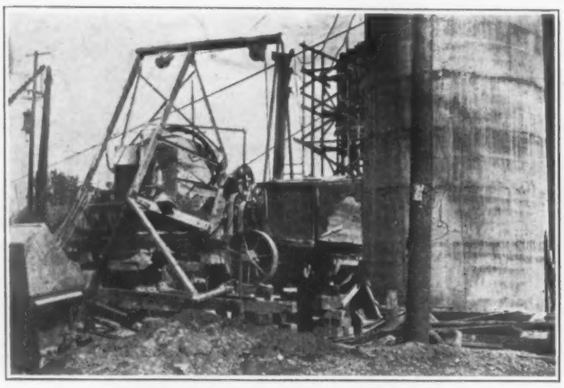


Fig. 3—Electrically Driven Cube Mixer.

One machine in particular is well worthy of note. It is the crane referred to above, which travels upon such a wide track and handles all the material from the water tunnel. Fig. 5 gives a head-on view of the machine, showing very plainly the manner of its construction from square timber and stock sizes of stuff. The width of track is discernible in this half-tone and also the manner in which the floor of the hoist is raised upon a sort of rudimentary truck to a plane several feet above the ground line. Taken in connection with Fig. 6 a very clear idea of the construction of the traveler may be obtained, enough to permit an engineer to use in other operations the excellent ideas there contained. The iron used in the derrick is nearly all plate cuttings, bolts and pins. There are very few forgings used, and such as are required are nearly all formed by bending plate or standard shapes of structural steel into very simple forms. Fig. 5 also shows the loading platform upon which a man stands to receive and dump the buckets of material as they are hoisted, one of the buckets being shown on top of the loading deck. This deck is picked up by the traveler and moved along as found necessary.

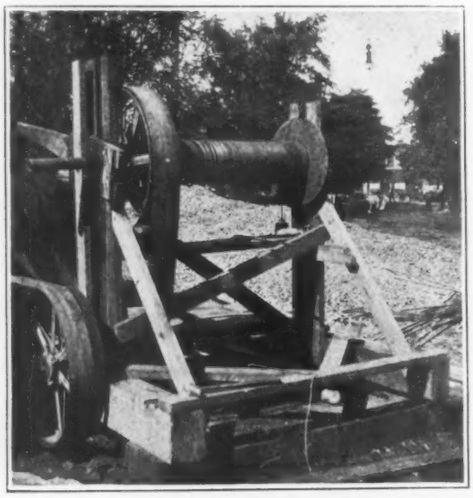


Fig. 4—Simple Brake Hoist for Stack Work.

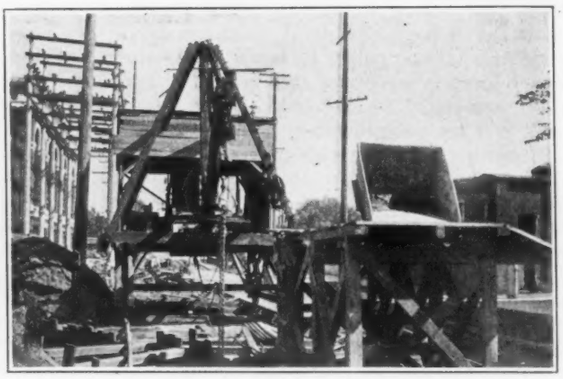


Fig. 5—Front View of Traveling Hoist.

The traveler is not self-propelling. A set of tackle rigged ahead and another set in the rear, with the lines therefrom brought into the traveler house, where they may be given a turn around the winch-head, furnishes ample propelling power, deadmen being located ahead and behind the traveler for attaching the towing tackle.

Fig. 6 shows very plainly the simple construction of the device. The boom consists of two timbers spliced to the required length. The truck frame consists of four more timbers laid in pairs with the wheels between and mounted on short shafts. Little further description is necessary, the bracing being plainly seen and the location of the hoisting engine over the rear axle furnishing ample load to prevent the tipping up of the traveler under any load it is required to handle in digging the ditch or placing the double line of conduit tile. It seems to the writer that the steelwork of this and of several other pieces of contractor's apparatus used upon this work has been designed with a view of being interchangeable and capable of being used in many future operations where derricks and travelers of different size and capacity may be required. To this standard steelwork timbering of required dimensions is fitted and the material-handling apparatus is put together quickly and with little expense.

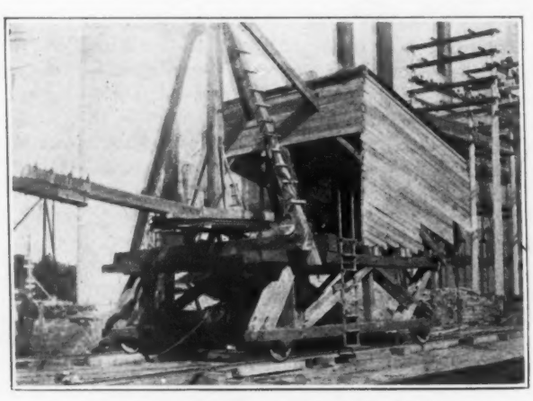


Fig. 6—Side View of Traveling Hoist.

South Bend, Ind. James F. Hobart.

QUESTIONS AND ANSWERS

In using air-cooled transformers in connection with rotary converters, how may one ascertain how much air to provide for the transformers? W. L. J.

The manufacturers usually specify 150 cu. ft. of air per minute for each kilowatt lost in the transformers.

What is the cost of running a circuit underground in large cities where the streets are paved with asphalt? A. M.

The cost would depend very much on the character of the subsoil. In New York, for instance, much of the work would require blasting of rock, which in many sections comes within a foot or two of the street surface. In another city of over 1,000,000 inhabitants with sandy subsoil it is stated that the cost of making a 100-ft. extension, including the replacement of asphalt, is approximately $350, $270 for material and $80 for labor. In the average American city the cost of running a tile duct on an asphalted street would approximate $1 a foot.

Why is it necessary to ground the frame of an alternator? L. L.

The Underwriters require the frame of a machine generating an emf greater than 550 volts to be permanently and effectively grounded, while one having a lower emf must be insulated wherever feasible. In addition a high-potential machine should be surrounded by an insulating platform, according to the Underwriters, so arranged that one must stand on it in order to touch any part of the machine. In an alternating-current system of distribution having many branches a fault in a cable is by no means an uncommon occurrence. If such a fault occur then everyone not insulated from earth is under the influence of this short-circuit to earth. If it were possible for current to flow through the fault and then through any one back to the machine it would result in shock more or less injurious. Many cases of shock are due to persons touching the frame of the machine, and this of itself should be sufficient reason for grounding a machine. With an insulated machine it is possible for a fault to occur in a cable and one in the winding of the machine at the same time and both pass unnoticed. With a grounded machine current would flow and the coils of the machine be more or less overheated according to the extent of the fault.

In the August number in an answer to a question asked by "W. T. W." it was stated that when two of the eight poles of a revolving-field generator are removed and the other poles are not redistributed the frequency of the delivered emf will be the same as formerly. The only change will be that the delivered emf will be decreased by 25 per cent and the voltage regulation will be poorer than formerly. I cannot see how you can remove two poles without changing the frequency. In the case of an eight-pole machine having a frequency of 60 cycles, for instance, the generator would run at 900 r.p.m. Why should not the frequency be reduced 25 per cent if two poles are removed just as the emf is reduced? If not, why is it necessary to have more than two poles on any frequency at any speed? F. J. F.

The method of determining the frequency of an alternator in cycles per second, by multiplying the number of poles by the speed in r.p.m. and dividing the result by 120, is applicable to any alternator constructed according to the ordinary method with uniformly distributed poles. That it cannot be applied directly to an eight-pole alternator when two of the poles are removed and the other poles are not redistributed is evident at once from the fact that the emf generated in any electrical conductor on the face of the armature changes its direction as it passes from under a north to a south pole. If it passes from a north pole to a south pole at the rate of 120 times a second, then the frequency of the emf is 120 alternations per second, or 60 cycles. The fact that throughout a portion of the revolution of the armature an individual conductor passes through a north pole of zero magnetism and also through a south pole of zero magnetism does not affect the frequency. It affects merely the emf, which in this individual conductor at this instant is therefore zero. Since this conductor is connected in series with other conductors which at this moment are under other poles of full magnetic strength, it is evident that the total emf of the armature is decreased merely in proportion to the reduction in the number of active poles.

I have a 45-hp, three-phase, 220-volt, 1800 r.p.m. induction motor which I desire to change so as to have it operate at 900 r.p.m. on a 440-volt circuit. Is there a book from which I can obtain the necessary winding data to suit this case, or if not how may the change be made? W. G. C.

We know of no book which will give you just this information. The motor is probably a 60-cycle machine, wound for four poles. In order that it may operate at 900 r.p.m. it must be rewound for eight poles. This change will involve an entirely new set of coils. The new coils should be wound with roughly one-half the slot-throw of the present coils, and should be built up with twice the number of turns of one-half the size of wire formerly used. If the coils are then arranged with one-half the present number of coils in each group, and the individual groups are connected continuously just as they now are, with the exception of there being twice as many groups as formerly, the machine should operate at 900 r.p.m. and should be suitable for an emf of 440 volts. However, the output will be somewhat less than before—that is to say, the machine cannot properly be rated as a 5-hp machine. The above instructions would be intelligible only to a person familiar with the winding of motors, but your attention should be called to the fact that no other person should be allowed to undertake the rewinding of the machine.

We will appreciate any information regarding a 50-hp, 220-volt, three-phase, 60-cycle, squirrel cage-type motor which we have. Through carelessness the shop boys ran a box dry on this motor the other day and it stuck fast; and after getting the journal in order the motor would not run. After an examination it was found that one side of the starting box, that is, one side of the three-cornered piece which goes next to the shaft in the rotor to which the starting lever is attached, was burnt. It was also found that one outside wire leading to the motor from the transformers was carrying very little current, while the middle wire seemed to be carrying too much, the middle knife on switch becoming red hot. We are unable to account for this as all the connections are correct. This high-voltage line also heats the motor very hot. G. M. M. & S.

Assuming that the motor mentioned could be started without difficulty before the accident, it is very probable that when one of the wires was found to be carrying more current than either of the other two wires the trouble was in the circuits external to the motor and not in the motor itself. That is to say, more than likely the load on the three phases of the generator was much unbalanced and the motor was taking most of its load through the phase of the generator which was loaded most lightly, attempting in this way to balance the load on the generator. This is an inherent characteristic of motors, but does not become prominent unless the load on the generator is markedly unbalanced. Trouble of this nature can be remedied only by balancing the load, or rather voltages, on the generator which supplies energy to the motor. Concerning the present trouble with the starting of the machine, it may be that the difficulty is in the rotor circuit, or there may be difficulty in the stator circuit. Again, it may be that trouble exists in both the rotor and stator. Assuming that you have examined the stator and found that the coils have not become burned, it is safe to assume that the trouble is in the rotor and is confined to the automatic starting rheostat. If this assumption is correct the only proper method is to dismount the rheostat, locate any burned-out places and make such repairs as then may be found to be necesary.

Central Station
Management, Policies and Commercial Methods

VISITING-NURSE SERVICE.

A recently established feature of the welfare work of the Commonwealth Edison Company, Chicago, is the visiting-nurse service. All absentees are reported promptly to the employment bureau and a registered visiting nurse, employed especially for the purpose, is sent to the residence of the absent employee on the same day. Advice or temporary professional assistance is given where needed, although the nurse cannot remain in attendance on any case of illness. The nurse turns in reports each morning on the calls of the previous day and these are forwarded to the heads of departments by the employment bureau. The service is of value both to the company and to employees.

FLAT-RATE CONTROLLERS AS WEDGES FOR METERED BUSINESS AT ROCKFORD, ILL.

The Rockford (Ill.) Electric Company has about fifty flat-rate controllers in use at the present time, although a larger number have been installed and later converted to metered business at the request of the customers. In its flat-rate service campaign the company has offered four 20-cp tungsten lamps for $1 per month, five for $1.25 and six for $1.50. No provision is made for connecting up heating appliances under this schedule or for cutting out the controller in case the customer desires to use all his lamps on some special occasion. The service is restricted purely to the lighting specified, and as the minimum flat rate, as well as the most popular, is $1 monthly, many such customers have preferred to be changed to service under the meter minimum of 50 cents a month. The controllers in service have been subjected to regular inspections at intervals of one or two months during periods when the work of the meter department is light.

During its wiring campaign the Rockford company is offering to wire a six-room house with porch and bath for $18. It will also furnish fixtures as follows: Parlor, three-lamp ceiling fixture, $2.75; dining-room, two-lamp, $2.25; kitchen, pendant, $1; bedrooms, two-lamp pendants, $2; bathroom, bracket, 80 cents; porch, 65 cents; hanging and connecting fixtures, $28.45.

BONUS FOR RAPID WORK.

Recently a contract was executed by which the North Shore Electric Company agreed to furnish electrical energy to the Edgar Allen American Manganese Steel Company, of Chicago Heights. The carrying out of this contract meant the abandonment of an isolated plant that had been furnishing power for the works and the building of a substation. Electricity is delivered to the consumer at 2300/4000 volts, three-phase, 60-cycle, and is reduced to 220 volts for shop-motor circuits and 110-220 volts for lighting. Two 110-kw, 220-volt rotary converters and two 500-ft. air compressors driven by 100-hp motors are included in the substation equipment, the cost of which was about $20,000. Fifty days before the time set for the completion of the work the president of the Edgar Allen company offered the North Shore company a bonus of $500 if the plant should be finished ready for operation thirty days ahead of time. This meant that the rotary converters and other necessary material must be shipped from the factory by express and extra pressure was put upon the work so that the load from the isolated plant was transferred from the new substation a month ahead of the time scheduled. The Edgar Allen company was much pleased and sent its check for $500 to the central-station company in recognition of this achievement.

PRACTICE METER DIALS FOR READERS' USE.

The Kentucky Electric Company, of Louisville, has had made an enlarged replica of a watt-hour meter dial about 4 ft. across for the use and instruction of its meter readers. The individual dials are 10 in. in diameter and the pointer of each is pivoted under a friction-screw setting so as to remain in any position as placed. This enlarged dial model has been found of much service in instructing new meter readers. After an explanation of the operation of the dials and practice in the simpler settings some of the more puzzling readings involving positions of the figure 9 are set up on the dials and the new men called upon to read them. The large dials are also of use where new men find difficult meter readings on their routes. In such cases a note is made of the position of the meter hands, the dial hands of the office model are set similarly and the proper reading is determined by one of the more experienced inspectors at the close of the day.

GUESSING ON KILOWATT-HOUR OUTPUT.

In previous years it has been the custom of employees of the Commonwealth Edison Company, of Chicago, to institute a guessing contest at the close of the year, the man coming closest to the highest maximum load of the winter in kilowatts getting the largest proportion of a pool to which each one entering the contest contributes. At the suggestion of the statistical department of the company, however, a change is made this year by which the largest day's kw-hour output has been substituted for the largest day's maximum load. It is suggested that a large kw-hour output is more desirable than a high maximum demand. For the last three winters the largest day's output has been as follows : Jan. 7, 1909, 1,510,250 kw-hours; Jan. 4, 1910, 2,162,235; Jan. 5, 1911, 2,355,760. If bright, clear weather prevails the output will be comparatively low and if the weather is dark the output will be comparatively high; also, if moderate weather prevails the output will be comparatively low, and if the weather is cold the consumption will be greater, due to the large street-railway heating load in Chicago.

ONE WAY TO GET MOTORS INSTALLED.

Sometimes prospective motor users who might well afford to enjoy the economies of electric drive are frightened at the first cost of the installation. Mr. David Davis, of Litchfield, Ill., before the Illinois Electrical Association convention at Rockford, Oct. 25, told of such a prospective customer, who declared he could not afford the expense of putting in the motor the central-station men suggested. Some time later a manufacturer's representative, who was a cheerful talker, visited Litchfield, and after a friendly conversation with the obdurate prospective customer found out how much the latter was willing to spend for electric drive. Easily adapting the requirements of the drive to

this price, the salesman figured out an installation and took the order. When the motor was installed it at once proved too small for the load, as the central-station men had predicted, and the energy it consumed far exceeded the estimate made by the salesman. The customer was plainly worried by this time, but, having got his feet wet, philosophically decided to plunge in all the way and ordered the size of motor that had been suggested for him in the first place, paying the full price. Of course, once installed, this motor drive has proved a source of much satisfaction and economy to him, but it is probable that the installation could have been made in no other way than by the course taken.

LETTERS THAT AID THE MOTOR SOLICITOR.

Sometimes good work with a prospective motor-service customer can be accomplished by starting him to think in his own way of what might be done to lower his operating expenses and improve his motor service. Men of large business interests are often too busily occupied to give the central station's solicitor the attention necessary to go into the proposition to the point where its attractiveness is fully revealed. If a letter containing the nub of the situation at a glance can be brought to the notice of the busy manager his interest is at once stimulated. The average soliciting letter is prosy and perhaps finds its way to the waste-basket after a glance at the heading.

A novelty calculated to catch the eye of the reader has been introduced by the Rockford Electric Company, which attaches characteristic load-curves or illustrations to the tersely worded communications it sends out. While the ordinary letter of this kind would reach the waste-basket, the unusual appearance of the pictures or diagrams contained in the Rockford letters provokes a second glance. Since the machines illustrated are of the types used in his own factory and in the load-curve the manager recognizes the shortcomings of his own installation, his interest is likely to be stimulated to the point where on his next call the salesman meets a lot of ready questions about motor-drive, first cost and operating expense.

EXPERIENCE WITH TUNGSTEN SIGN LAMPS AT JOPLIN, MO.

The experience of central-station companies with low-voltage tungsten sign lamps has been one of varied degrees of satisfaction, according to reports obtained from those having the maintenance of such installations in charge. To series-multiple arrangements of such lamps, however, can usually be traced most of these troubles, the failure of one lamp of a group so overloading its fellows that they in turn rapidly succumb.

The Empire District Electric Company, which operates in Joplin and Webb City, Mo.; Galena, Kan., and other cities of the famous lead and zinc mining districts, began the use of tungsten sign lamps in 1909. After opening up its commercial department the first sign sold was to an undertaking establishment, as noted in these columns Oct. 7. This sign was equipped with carbon lamps. The second display went to a bank, and, it being decided that the bank's sign should appear more "lively" than that of the undertaker, tungstens were used for the first time. Ever since the company has advocated the use of tungsten sign lamps exclusively.

It now has 15,000 such lamps, used continuously from dusk until midnight, with free renewals, and, according to Mr. J. E. Harsh, commercial manager of the company, tests made show that the full rated life of the lamp is being obtained, while breakage in handling is reported slight.

LIGHT LAMP-DELIVERY WAGON.

The Rochester Railway & Light Company has recently placed in service its first lamp-delivery wagon, thereby rendering it unnecessary for patrons to come to the office with lamps they desire to have changed. Heretofore consumers entitled to free lamp renewals had to come to the office of

Rochester Lamp-Delivery Wagon.

the company with an identification card to obtain new lamps. Now a girl in the lamp department receives telephonic requests for renewals and the calls are routed for the driver of the wagon. The latter is built on a Baker chassis with shaft-drive and averages 45 miles a day. The top is of mahogany and holds approximately 800 lamps in standard packages. On the floor in front of the driver there is a box for lamps other than standard. The wagon is of the light pleasure-vehicle type and is completely inclosed. The company expects to install two more wagons of the same type shortly, indicating satisfaction with the system and with the wagon as well.

CHEAP POLE LINES AND THE USE OF IRON-WIRE SECONDARIES.

Following a symposium on electric service to agricultural communities at the Rockford convention of the Illinois State Electrical Association, Oct. 25, the discussion turned on the subject of cheaply constructed distributing lines and the use of iron wire for distributing circuits. Mr. Theodore Bass, of Farmington, Ill., described a service to a group of three farms supplied with energy from his 16,500-volt transmission line. The farmers hauled and erected the poles, paying $200 for the high-tension step-down transformer and the three distributing transformers. Iron wire is used for secondaries. Mr. A. O. Brown, of Elmwood, however, cited an instance where he had attempted to operate a 5-hp motor at the end of a mile extension of No. 8 iron wire, but found the motor would deliver hardly 2 hp. Mr. W. G. Austin, of Effingham, on the other hand, reported the successful operation of a 7-hp motor at the end of a mile of 2200-volt line of No. 10 iron wire. Mr. E. J. Negley, of Canton, spoke of trouble with fuses and transformers used on a 2-mile transmission line to a coal mine. This line was later protected by stringing a No. 2 copper ground wire, earthed at every third pole. Mr. R. H. Abbott, of Petersburg, cited the construction of 2 miles of country line for $445, the farmers furnishing the labor. Another member declared he had constructed 32 miles of 1100-volt line, using No. 6

hard-drawn copper wire on 30-ft. poles, at a cost of from $150 to $200 per mile.

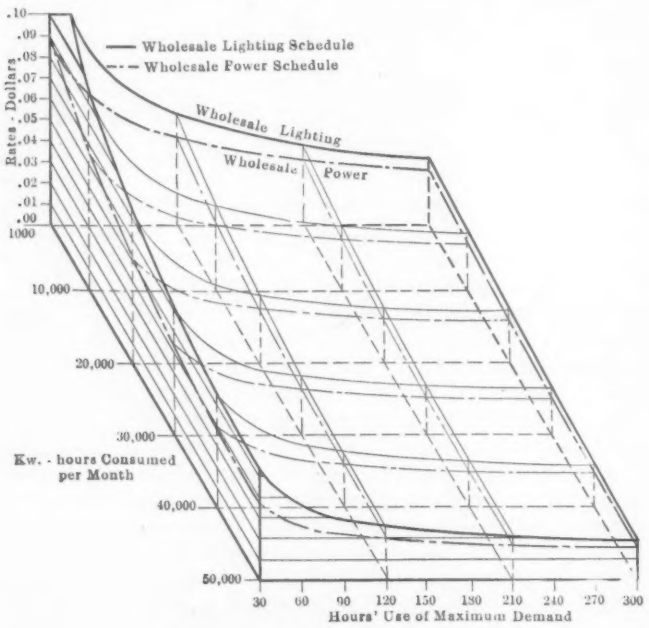
Mr. S. B. Cushing, of Chicago, pointed out that iron wires when used should be tested at frequent intervals for strength, since they are seriously attacked by rust. The occurrence of a single accident from fallen line wires, he observed, might prove much more expensive than the cost of many miles of first-class construction.

Dr. E. J. Berg, of the University of Illinois, explained that for all practical purposes within 1 per cent the effects of self-induction can be disregarded in the case of iron wire. Mechanically, he added, copper has the great advantage of resisting rust. For such discharge paths as lightning rods the material of the conductor has little effect, the form of section, however, being very significant, since the law of loss by induction follows the law of torsion. Professor Berg also explained the discharge of lightning surges by corona in the case of certain 110,000-volt transmission lines which are without other arresters. In these cases the diameter and section of the conductor is of more importance than its material.

Mr. Frank J. Baker, of the North Shore Electric Company, Chicago, discussed briefly the problem of the cost of making service extensions. The durability of cheaply constructed lines like those already mentioned is open to question, he said, after they have been in use five years or more, while a single accident may cost the equivalent of the interest on many miles of first-class lines. It has not been the policy of the North Shore Company, said Mr. Baker, to ask the prospective consumer to pay any part of the cost of extension, the company taking the view that if the business is worth going after at all it is worth the preliminary cost of construction.

WHOLESALE RATES FOR ELECTRIC SERVICE AT CINCINNATI.

In connection with the newly established rate schedule of the Union Gas & Electric Company, of Cincinnati, Mr. J. W. Lyon, commercial manager of the electrical depart-



Rate Diagram for Wholesale Service.

ment, has had drawn up an isometric solid diagram of the rates for wholesale lighting and motor service as given in tabular form in its schedule book. The co-ordinates used are kw-hours monthly consumption and hours' use of the maximum demand, the corresponding rates in cents per kw-hour being shown as vertical distances from the ground plane. The Cincinnati wholesale rate, as shown in the accompanying reproduction, forms a perfectly smooth surface, without breaks or steps, for both lighting and motor service. At the upper left-hand corner of the sketch is shown the intercept of the lighting rate by the city ordinance. The motor-service rate is indicated by the dotted surface just below that representing the lighting schedule. As noted in a preceding issue, the wholesale lighting schedule ranges from the ordinance rate of 10 cents down to the minimum of 1.88 cents per kw-hour for a consumption of 50,000 kw-hours used during 300 hours' equivalent. The wholesale motor-service rate similarly ranges from 9.02 cents per kw-hour for 1000 kw-hours at thirty hours' use down to 1.5 cents for 50,000 kw-hours at 300 hours' use. As is revealed by the developed rate surfaces, the new schedule properly puts a premium on long-hour use rather than on the consumption of a large quantity at poor load-factor.

FARMERS' SERVICES TAPPED FROM A 13,000-VOLT TRANSMISSION LINE.

A number of farmers along the 13,000-volt transmission line of the Liberty Light & Power Company, which connects Liberty, Ind., with the generating station at Richmond, 18 miles distant, are furnished electric-lighting service through 1½-kw transformers, reducing from the transmission potential to the 110 or 220-volt secondary pressures in a single step.

By grouping, two or more farm customers are supplied from the same 1½-kw transformer. The first transformer out of Richmond, 3½ miles distant, serves four farms, and at two-mile intervals are two other groups of two each, the fourth and last group being 14 miles from Richmond and the power house.

The transformers are mounted on the poles carrying the 13,000-volt single-phase transmission line. To protect them against the weather it has been found necessary to provide a housing completely inclosing the transformer cases, the fuses being left exposed so as to be accessible. Home-made horn-gap lightning arresters are constructed out of No. 4 copper wire, and mounted on insulators. During the summer lightning season these gaps are reduced to an opening of ¾ in., but in winter they are bent back to a clearance of 1⅛-in. to guard against shorting by sleet and snow. Solid grounds have been used on these 13,000-volt arresters, but as a result of local experience on nearby 6600-volt lines with home-made high-resistance grounds, these are to replace the solid grounds, which have given trouble because of the circuit-breakers opening as a result of static discharges. The high-resistance grounds are made by burying blocks of wood, 4 in. by 4 in. by 18 in., several pounds of wet salt being scattered about the wood to provide a conducting moisture. Bare No. 8 copper wire is used for customers' 220 and 110-volt secondaries, some of which approximate half a mile in length.

The farm services on the Liberty-Richmond line were installed in deference to the demands of the farm owners, rather than as a result of central-station solicitation. The farmers are required to buy their own transformers, which are installed by the company at the customers' expense. The company furnishes and maintains the meters for each customer, however, free of cost.

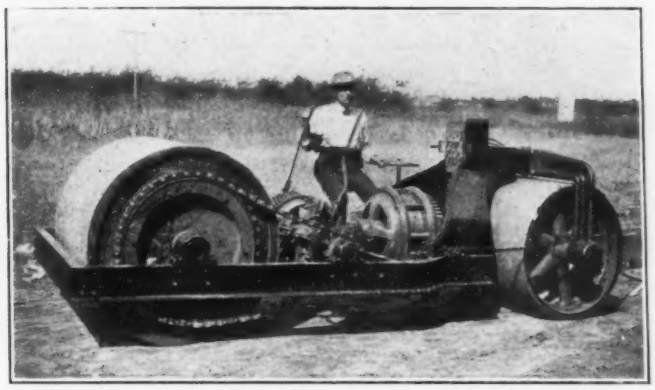
As an example of the connection cost to the customers, the two farmers composing the last group connected paid together $250 for their transformer, 1500 ft. of bare-wire secondary pole line, and the wiring of their premises. Each farm customer is charged a fixed transformer-loss cost of $1 per month, to which is added the cost of the energy consumed. The rates for the latter element run 13 cents per kw-hour for the first 30 kw-hours, 10 cents for the next, 8 cents for the next and 6 cents per kw-hour

thereafter. Meters are read at three-month intervals, the average income from each customer per quarter being about $5. All of the present farm customers are well-to-do, and have as many as twenty lamps in their homes, but they are, of course, proverbially early to bed, and their hours of lamp use are short.

In spite of the twenty-four-hour service, no motors are yet in use for pumping or other farm work, although several fans and irons are now connected up. In this respect much more development is to be expected on the Liberty line. As a business proposition it is doubtful whether the farm business is profitable to the central station, and indeed whether a company is justified in cutting into a 13,000-volt or 6600-volt line to serve one or two small consumers. The departure at Liberty is looked upon only as an experiment by the company, which has nearly 35 miles of transmission lines connecting nearby towns. Mr. R. S. Ashe is president and manager of the company and Mr. H. A. Wehrly is superintendent.

A MOTOR-DRIVEN ROAD ROLLER.

The motor-driven road roller shown in the accompanying illustration is used by Mr. George Stump, a contractor, for rolling roads and paving streets in Independence, Kan. The roller is operated by a 10-hp, 220-volt, single-phase motor, to which energy is supplied through 160 ft. of flexible cable from a portable step-down transformer mounted on cartwheels. The primary side of this transformer can be tapped on to any 2300-volt, single-phase distribution circuit in the neighborhood of the street to be



Contractor's Paving Roller Driven by 10-hp Single-Phase Motor.

paved, and the flexible cable carried by the roller is long enough to roll any local 300-ft. block. When the roller is to be used at a short distance from the existing transmission lines of the company the necessary poles are quickly set and the line extended at cost to the contractor. Paving work to be done, however, is usually already reached by the company's lines, and then it is only necessary to run a drop to the transformer cart.

This cart also carries a watt-hour meter, which is read at regular intervals like any other customer's meter, the contractor paying 10 cents per kw-hour for the energy used. At this rate the cost of operating the roller in paving a block of street has averaged $6, which includes rolling the rough ground before applying the crushed rock, rolling the crushed rock and then finally rolling the finished brick paving. The cost of operating the electric roller, the contractor declares, is much less than maintaining an equivalent steam roller.

The motor-driven roller weighs, complete, 15,000 lb. with the motor in place. The motor runs at 1200 r.p.m. and has its speed reduced by a gear and pinion, the latter's slow-speed shaft ending in a bevel pinion which drives two facing gears in opposite directions. By means of clutches the sprocket-wheel shaft which chain-drives the rear roller can be clutched on to one or the other of the bevel wheels for driving the roller in the forward or reverse direction. The motor thus remains running during ordinary operation, starting and stopping of the roller being controlled by the clutches. The motor is provided with a starter near the operator's seat, but is accelerated idle before the drive is clutched in. The driving roller is 4 ft. in diameter and 4 ft. 6 in. wide, while the front roller is 3 ft. in diameter. In a number of months' operation the roller has proved its ability to climb almost any kind of a grade, even through the most difficult material. It has been operated up grades of 8 per cent, and as a try-out test was made to run over a series of 8-in. x 8-in. timbers placed 2 ft. apart.

The roller was designed by Mr. Stump and Mr. W. R. Murrow, manager of the Independence Electric Company, and was built by the United Iron Works, of Independence.

CENTRAL-STATION DEVELOPMENT AT FARGO, N. D.

A Plant with One Consumer to 5.33 Inhabitants.

The commercial development of the central-station business at Fargo, N. D., by the Union Light, Heat & Power Company presents the unusual record of one electric-service customer to every 5.33 inhabitants. This record, which is equaled by comparatively few if any electric light and power companies of the United States operating in cities as large as Fargo, is a testimonial both to the enterprise of the central-station management for a number of years past and to the general progressiveness and prosperity of the population of Fargo.

By the 1900 census Fargo, N. D., had a population of 14,331. The increase of population was 49 per cent in ten years. Fargo is the metropolis of North Dakota and western Minnesota. It is the center of a great wheat-raising country. There is comparatively little manufacturing, but there are fifty-six wholesale and jobbing houses and distributing agencies serving the large territory of which Fargo is the center. There are fifty-seven manufacturing industries. Just east of Fargo across the Red River in Minnesota is the city of Moorhead, with a population of about 5000. Following are some interesting facts and factors bearing on the development of this business.

On Sept. 1, 1911, the company had 2524 metered lighting consumers, 138 metered power consumers and twenty-five flat-rate consumers, mainly on window-lighting and sign contracts. The connected load in incandescent lamps was 2161 kw. There were 117 500-watt commercial arcs, 806 electric flatirons and five moving-picture machines; ten flaming arcs, miscellaneous heating and other appliances to the number of seventy-two of 500 watts capacity each average; metered signs, fifty-one, containing 2362 lamps; flat-rate signs, forty-nine, containing 3126 lamps. The total connected commercial lighting load, exclusive of power and heating, was 2437 kw. For municipal lighting there are 139 arc lamps taking 550 watts each and 209 40-watt tungsten lamps. In addition to these for special downtown street lighting there are 137 five-lamp ornamental posts, each post taking 340 watts. The total connected city lighting load is 125 kw. The total of city and commercial lighting loads is 2563 kw. The power load consists of sixty-five alternating-current motors with a total horse-power of 293 and 303 direct-current motors with a total horse-power of 1384. The total motor load is 1258 kw. The company also furnishes power to the street railway, which is figured for statistical purposes as a connected load of 123 kw. Including this the connected load for all purposes figures 3945 kw. The alternating-current portion of the system is supplied through 138 transformers with a total capacity of 861 kw. There are

39.3 miles of pole lines. This is equivalent to about 80 ft. of pole line per consumer. The station capacity is 1610 kw, which is equivalent to about 60 watts per capita of population. The maximum demand on the station Sept. 1 was 1205 kw. The load-factor for the week ended Sept. 1 was 28 per cent.

The lighting rates are based on 11 cents per kw-hour for the first 100 kw-hours, 9 cents for the second 100 kw-hours and step-by-step reductions for additional amounts until all energy over 10,000 kw-hours per month is sold at 3.55 cents. The power rate for the first 500 kw-hours per month is 6.66 cents, with step-by-step reductions for amounts in excess of this consumption. The customary discount of 10 per cent for prompt payment of lighting and power bills is allowed. The company is owned by the Northern States Power Company, which in turn is controlled by H. M. Byllesby & Company, of Chicago.

ADVERTISING ELECTRICAL NOVELTIES.

The general public now knows that devices for adding to the convenience of home operations are on the market, and may be had of dealers or central stations, many of which have departments for the sale of equipment of this kind. The problem before the new business department in seeking to build up a larger consumption of energy in the operation of domestic apparatus, then, is to present the advantages which it possesses in a striking form, and one that will attract attention.

While the newspaper advertisements and other notices issued by the company may refer effectively to this branch of the business, it has been found by many managers that a graphic display is better than any other kind. Actions speak louder than words, and the pictorial presentation of electrically operated irons, toasters, etc., is much more effective than when one is merely told about it. In solving the question of graphic display one idea worth general adoption is the distribution of photographs in the form of post-cards, each of the pictures showing some phase of domestic economy in which electricity plays a part.

The traffic manager of an Ohio Valley lighting company decided that in order to get the best results he would make his own photos, instead of buying them from novelty manufacturers, who frequently offer the same sort of picture to a dozen different users. He succeeded in securing the services of two well-known young women of that city, and they agreed readily to pose for his camera. The result was that he secured a series of pictures which are attractive merely as photographs, and which are certain to be kept by the people who receive them. The series consists of fifteen views, some of which are reproduced herewith.

Fig. 1—Post Card Advertising Use of Toaster.

The post-cards upon which the pictures have been mounted are sent out at regular intervals to a selected list of consumers, care being taken to select those most likely to be in the market for modern devices for the home. This particular company maintains a department for the sale of equipment of this sort at its general offices, and it is reported that a healthy increase in the demand has been noted since the cards have been in circulation.

Fig. 2—Post Card Advertising Use of Percolator.

EASILY UNDERSTOOD STATEMENTS OF RATES.

Rates for electric service which involve a discount on a part of the bill, which discount is based on a certain number of hours' use per month of a consumer's connected load or maximum demand, or upon some assumed maximum demand calculated from his connected load, have long been common among the more progressive electric-service companies and recently have been required in most of the cases before the Wisconsin Railroad and Public Service Commission where that commission has specified the rates to be charged. The principal valid objection urged against this system has been the difficulty of stating the rate in such a way that the consumer can understand it. It is probable that the majority of consumers who are served with electricity under such rate systems do not really understand the rates. It, therefore, should be a matter of much study on the part of the electric-service company to state its rates in as popular and easily understood language as possible, avoiding technical terms except where absolutely necessary and remembering that the every-day language of the man in the central-station business is worse than Greek to the ordinary consumer. The following suggestions as to the wording of published rate sheets are offered by a manager who has given the matter considerable thought and has drawn up the rate sheets for a number of companies. They represent an attempt to state the case in plain language so that the ordinary consumer or uneducated employee of the company can easily figure the rate on any consumer's installation.

In order to make matters plain to the electric-service company reader who may wish to know the foundation of the rate specified before seeing its popular statement, an example is given of a rate sheet, first as it was actually drawn up by the manager in technical language, showing the fundamental derivation of the rate, and second the

popular statement of the rate as made up for publication. The actual figures given are, of course, simply for the purpose of an example and only represent the practice of one company with a given set of local conditions. The following is the technical statement of the rate system.

TECHNICAL STATEMENT OF RATES.

Electric lighting rate: 14 cents per kw-hour for electrical energy used equivalent to thirty hours' use per month of the consumer's maximum demand, the maximum demand being estimated by the rules given below. For electrical energy used in excess of one hour's use per day of the consumer's maximum demand, 6 cents per kw-hour. Minimum bill, $1 per month.

The following are rules for estimating the maximum lighting demand:

For stores, offices, depots, restaurants, livery stables and all places of business where all the lamps are lighted during the company's heavy-load period, that is from 5 to 6 p. m. in winter, the maximum demand shall be counted as the full connected capacity of lamps.

For hotels and boarding houses, public halls, churches and theaters the maximum load shall be counted as one-half the connected capacity in lamps.

For residences count the maximum demand as 40 watts for each room in the house, exclusive of bathroom, basement, porches, stairways, attics, storerooms, small halls, entrances, woodshed and barn. Small motors of ½ hp and less and electric irons or other heating appliances are not counted.

Unlimited power rate: Twelve cents per kw-hour for electrical energy used equivalent to thirty hours' per month of the consumer's maximum demand, the rules for estimating the maximum demand being given later. Six cents per kw-hour for electrical energy used in excess of the foregoing amount.

Off-peak power rate: Power consumers agreeing not to operate motors between 4:30 and 8 p. m. during November, December, January and February will be given the regular unlimited power rate less 4 cents per kw-hour on the 12-cent portion of the bill.

Minimum bill, $1 per horsepower connected per month.

The rule for estimating the maximum power demand of a consumer is to take 1 kw per horse-power of motor connected, except where a motor is much underloaded and consumer desires a test. In such case the company will make a test for such period as seems to it best to determine the real maximum demand.

POPULAR STATEMENT OF THE SAME RATES.

"Electric light, 14 cents per kw-hour for the first portion of the monthly bill and 6 cents per kw-hour for the second or remaining portion. The number of kw-hours in the first portion is determined as follows:

"For stores, offices, depots, restaurants, livery stables and all places of business multiply by 30 the connected capacity of the lamps in kilowatts.

"For private residences multiply the number of rooms in the house by 1.2 kw-hours, but do not count bathrooms, basements, cellars, porches, stairways, attics, storerooms, small halls, entrances, woodsheds and barns.

"For hotels, boarding houses, public halls, churches and theaters multiply by 30 the connected capacity of the lamps in kilowatts and divide by 2.

"Do not count flatirons, heating and cooking appliances or vacuum cleaners as connected load.

"When the kw-hours used in a month as shown by the meter are equal to or less than the first portion the rate on the whole bill is 14 cents per kw-hour.

"When the kw-hours used in a month exceed the first portion all of the kw-hours of the first portion are to be billed at 14 cents and all in excess of the first portion are to be billed at 6 cents per kw-hour.

"The number of kilowatts taken by various kinds of incandescent lamps to be used in estimating under the foregoing rules is as follows:

Kind of Lamps.	Kilowatts.
16-cp carbon-filament	.050
8-cp carbon-filament	.030
32-cp carbon-filament	.100
20-cp tantalum-filament (40-watt)	.040
40-cp tantalum-filament (80-watt)	.080
20-cp tungsten-filament (25-watt)	.025
32-cp tungsten-filament (40-watt)	.040
48-cp tungsten-filament (60-watt)	.060
80-cp tungsten-filament (100-watt)	.100
120-cp tungsten-filament (150-watt)	.150
200-cp tungsten-filament (250-watt)	.250
350-cp tungsten-filament (400-watt)	.400
450 cp tungsten-filament (500-watt)	.500

"The minimum monthly lighting charge is $1 for service, and no service will be accepted or billed for less than this amount.

"Power rates on unlimited contract: 12 cents per kw-hour for the first portion of the bill and 4 cents per kw-hour for the second or remaining portion. To determine the first portion, multiply the horse-power of the motor by 30.

"Power rates on limited off-peak contract: 8 cents per kw-hour for the first portion of the monthly bill and 4 cents for the secondary or remaining portion. Consumers accepting this limited off-peak power rate must do so with the express understanding and agreement that in consideration of the reduced rate they are, when requested by the company's representative, to discontinue operation of motors between 4:30 p. m. and 8 p. m. between Oct. 15 and Feb. 15 whenever the company's reserve plant capacity is needed during these hours for other purposes.

"No power service will be rendered for less than $1 per horse-power or fraction thereof of motor connected per month.

"Voltage: The company will aim to maintain as near as possible to 109 volts at consumer's lamp terminals if buildings are properly wired, and 218 volts at motor terminals.

"A kilowatt is equal to 1000 watts, thus ten 100-watt tungsten lamps equal 1 kw of connected load."

There is another popular method of stating the same rate system which may appeal to some as being easier to understand at first reading than the foregoing. This method of statement is based on the discount idea and may appeal to some minds more easily than the foregoing method. The same rates stated according to the discount method would be as follows:

ANOTHER POPULAR STATEMENT OF THE RATES.

"Electric light: 14 cents per kw-hour. A discount of 8 cents per kw-hour will be given on whatever portion of a consumer's monthly bill exceeds said consumer's discount limit. This limit is figured for each consumer thus:

"For stores, offices, depots, restaurants, livery stables and all places of business multiply by 30 the total capacity in kilowatts of the lamps connected.

"For private residences multiply the number of rooms in the house by 1.2 kw-hours, but do not count bathrooms, basements, cellars, porches, stairways, attics, storerooms, small halls, entrances woodsheds and barns.

"For hotels and boarding houses, public halls, churches and theatres multiply by 30 the connected capacity of the lamps in kilowatts and divide by 2.

"Do not count flatirons heating and cooking appliances or vacuum cleaners as connected load.

"When the kw-hours used in a month exceed the consumer's discount limit as figured by the rules just given the kw-hours in excess of the discount limit will be billed at a discount of 8 cents per kw-hour from the base rate of 14 cents, or, in other words, at a net rate of 6 cents per kw-hour."

Where there are more than two rates the terms "first discount limit," "second discount limit," etc., can be used.

Wiring and Illumination

AN ELECTRIC FOUNTAIN IN THE CLASSIC GARDEN OF A NEW ORLEANS PRIVATE HOME.

The central feature of an exquisitely arranged Italian garden covering the terraces of the magnificent St. Charles Avenue residence of Mr. Lawrence Fabacher, of New Orleans, is an electric fountain, on which is projected the colored illumination of a 30-amp arc lantern. The color changes in the lantern are effected by a revolving disk driven by a small motor, the entire lamp and mechanism being concealed in the structure above the fountain. The display was designed by Mr. Fabacher and executed locally, having been completed only within the last few days. The cost is reported to have been several thousand dollars, so that such fountains are not likely to become household necessities in modest homes, according to Mr. W. E. Clement, contracting agent for the New Orleans Railway & Light Company, which furnishes the electrical energy. The effect of the changing hues on the bubbling water is declared to be most pleasing amid the dark settings furnished by the classic garden.

METHODS OF SOLDERING WIRES IN TERMINAL LUGS.

By H. D. George.

Where many terminal lugs are to be soldered to conductors a convenient and time-saving method of making the connections is to melt a pot of solder over a plumbers' furnace, pour the solder in the hole in the lug and then plunge the bared end of the conductor into it, as shown in Fig. 1. The insides of the holes of all commercial lugs are "tinned" so the solder adheres to them readily, and the bared end of the conductor should also first be tinned. This may be done as follows: The end of the wire is carefully scraped with a knife or with a piece of fine sandpaper (the sandpaper is best because it cannot nick the wire) and then smeared with soldering flux and thrust into the solder pot. If a soldering stick is used the wire must be heated somewhat in the solder before the stick compound will melt and adhere. It requires but a fraction of a minute to "tin" the wire end in the pot. After removal the end should be knocked against some solid object to remove surplus solder.

Immediately after the tinned end is pushed into the

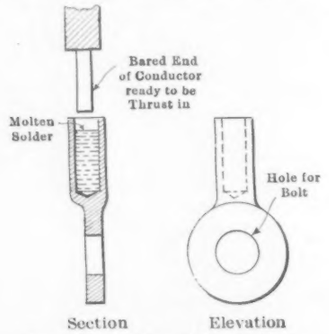


Fig. 1—Soldering Wire in Lug.

hole in the lug the lug should be soused with a piece of wet waste to cool it rapidly. The job is finished by scraping or filing off any shreds or globules of solder that adhered to the exposed surfaces of the lug and by brightening it with fine sandpaper if necessary.

The insulation from the conductor ends should be cut back just far enough so that it will abut against the shoulder of the lug, as suggested in Fig. 2 *A*. The appearance is very unsightly and indicates careless work if there is a gap between the shoulder and the insulation, as at *B*. If

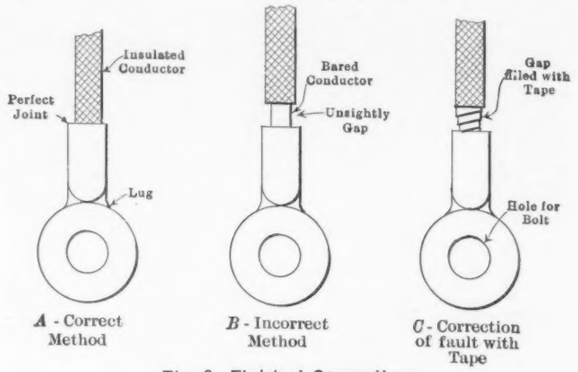


Fig. 2—Finished Connections.

because of some mishap a connection does result, having the appearance of Fig. 2 *B* a partial correction can be made by filling the gap with servings of tape, as shown at Fig. 2 *C*. The tape of the standard ⅞-in. width should be torn into strips about ¼ in. wide before applying.

Only enough molten solder should be poured into the hole in the lug to fill it almost to the brim when the conductor is in position. If too much is poured in it will be squeezed out by the wire and will flow over the lug. It must then be removed at a sacrifice of time.

Another method of soldering wires in lugs is to heat

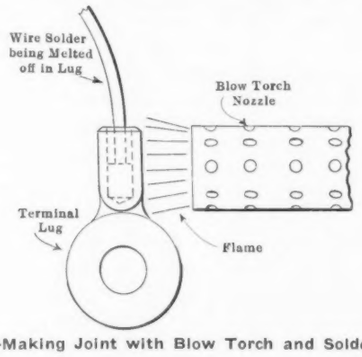


Fig. 3—Making Joint with Blow Torch and Solder Wire.

the lug with a blow-torch flame, as outlined in Fig. 3. When the lug is sufficiently hot wire solder is fed into the hole. The solder melts and the bared conductor end is then thrust into it, as above described. However, the use of a blow torch in this way should be avoided if possible, as it blackens the exposed surfaces of the lug. A thorough cleaning with fine sandpaper is then necessary, and that requires considerably more time than is justifiable.

CANDLE-POWER LIFE PERFORMANCE OF INCANDESCENT LAMPS.

By G. S. Merrill.

The mean spherical candle-power or the total lumens generated by a light source is the proper basis for judging its performance. This fact is generally recognized and needs no discussion. In calculations and tests involving incandescent lamps it has been the common practice to use the mean horizontal candle-power as a basis from which the mean spherical candle-power could be derived if desired, by the use of reduction factors* applying to the particular

*Reduction factor $= \left(\frac{\text{Mean spherical candle-power}}{\text{Mean horizontal candle-power}}\right)$

type, kind and size of lamp under consideration. It has been found that the reduction factor is very uniform for new lamps of the same kind and hence can be used as an easy way of obtaining the initial mean spherical candle-power from measurement of the mean horizontal intensity. However, the use of a reduction factor may give misleading results when applied to other than the conditions for which it has actually been determined. The common acceptance and use of mean horizontal candle-power as indicating lamp performance, on the evident assumption that the total light flux bears a constant relation to the horizontal intensity, has led to considerable error in judging the true performance of some types of lamps.

In the case of the regular tantalum lamps the effect of service is to darken the bulb in a distinct band about the horizontal projection of the filament, due to the concentration of the filament in a relatively short axial length and to the proximity of the filament to the side of the bulb. This distribution of blackening serves to reduce the mean horizontal candle-power. However, it is important to note that the reduction in mean horizontal candle-power results only in part from the absorption of light by the darkened band and that a part of the reduction is due to the fact that some of the light that would normally pass through the bulb in a horizontal direction is *reflected* from the deposit of the sloping sides of the bulb through the tip end of the lamp. The mean spherical candle-power, therefore, does not decrease nearly as much as does the mean horizontal in this case, and consequently the change of mean horizontal candle-power with service can be no criterion of the real lamp performance. Since light is reflected through the tip end of the lamp as it becomes old the mean lower hemispherical candle-power does not decrease as much as either the mean horizontal or mean spherical. The same general considerations that apply to the tantalum lamps apply to those tungsten-filament lamps whose construction is somewhat similar, and point to the conclusion that changes in mean horizontal candle-power with service should not be used in judging the performance of different kinds, sizes and types of lamps, since the corresponding changes in total light flux may be very different in different lamps.

In carbon-filament lamps the filament conforms somewhat to the shape of the bulb and the blackening is distributed much more uniformly over the side and tip end. Consequently the reduction factor changes only a very little with service, so that the total light flux varies approximately in a direct ratio to the mean horizontal candle-power during the normal life of the lamp. When the mean horizontal candle-power of a clear 110-volt, 50-watt or 60-watt carbon lamp in a straight-sided bulb has reached 80 per cent of the initial value, the mean spherical candle-power will have reached approximately 80 per cent of its initial value also, whereas when the mean horizontal candle-power of a clear 40-watt, 110-volt drawn-wire tungsten-filament in a straight-sided bulb has dropped to 80 per cent mean horizontal its mean spherical candle-power will be about 85 per cent of the initial. In order that the latter lamp may show the same percentage depreciation in mean spherical candle-power as the carbon lamp it should be run to about 75 per cent mean horizontal rather than to 80 per cent, and since for this particular lamp the hours to 75 per cent or previous burn-out are nearly 20 per cent greater than the hours to 80 per cent or previous burn-out, it is evident that to judge its performance on the basis of life to 80 per cent mean horizontal candle-power in comparison with carbon lamps to the same percentage is exceedingly unjust.

It is important to express the performance of metal-filament lamps in terms of total light generated rather than in terms of horizontal intensity, since otherwise these lamps receive no credit for a part of the light flux they produce, and they are at a considerable disadvantage where the life is estimated to 80 per cent of initial mean horizontal intensity rather than to 80 per cent of the mean spherical intensity which corresponds to the commonly accepted "useful life" of carbon lamps. The fact that the reduction factor changes in a different manner and in different amounts according to the size and shape of bulb, to the disposition of the filament in the bulb, and finally to the initial specific consumption at which the lamps are operated, indicates the necessity of using the mean spherical candle-power performance on life test where comparative performance or where cost of producing light with different lamps is to be determined.

FIRE HAZARD AND INSURANCE RATES IN POWER PLANTS.

By C. J. Williams.

The subject of insurance costs to electrical plants is worthy of much better consideration than has usually been given it in the past by plant owners. A noticeable growth in interest has recently taken place and much is being written on the subject by operating electrical men. A salient feature of most of the discussions appearing in convention reports and the technical press is the entire absence of any comment on the various fire hazards existing in stations and the undivided attention given to insurance charges for the stations containing those hazards. The effect is attacked without reference to the cause.

Another point of interest is the apparent failure of insurance engineers to give due publicity to their methods for measuring fire hazards in this class of buildings. Out of this lack of co-operation observable between plant owners on the one hand and insurance companies on the other the tendency has been growing for the former to impute unjust discrimination against power plants in insurance ratings and for the latter to assume negligence toward undeniable fire hazards to be universal among plant operators. The community of interest actually existing should be able to overcome such petty barriers.

It may be admitted, for instance, that insurance ratings, though made from actual condition reports, may suffer at times from the inadequate appreciation by non-technical inspectors of influencing variations of power plants from ordinary types of construction and operation. Such reports will fail to give proper apportionment between structural and occupational hazards and give excuse for imputation of incompetency of the report and its result in rate estimates.

In passing, however, it is well to note that this lack of suitable knowledge by the inspector, with its resultant errors, has offsetting it a far more general lack of appreciation by light-plant managements of the elements of fire hazard in their building arrangements and use. Three out of four service companies could effect a reduction of 25 per cent in fire insurance by an ordinary thorough house cleaning. Many can do still more. And a saving in maintenance cost is contingent on the same class of improvements.

The dearth of information among plant owners on plant fire hazard is only such as might be expected from the low average proportion of the total number of fires to the total number of plants and the much lower number of fires due to any one of the many different causes.

If the chance of serious fire in any one plant is 1 per cent, the chance from, say, oily waste might be 1 in 10,000. The low total probability takes a serious fire into one plant only once in 100 years. It is not likely that the average management has ever even heard of a fire from workmen's clothing on steam pipes, from puncture in oil-reactive coils, or one of the hundred recorded causes. The plant man has been trained to figure on what happens 99 times out of 100, while the insurance estimates must note the happen-

ing in the ten-thousandth case as a considerable proportional hazard. A charge of 1 cent per $100 of insurance may be a considerable proportion of insurance rate on a particularly well-arranged station.

The insurance inspector is at least working from a definite rating schedule, which applies relative estimates to the value of each fire hazard in the plant. The fairness of any charge is a question of amount only, and this must be determined by the experience which has been recorded, either by insurance companies or the power plants themselves.

The Underwriters' standards set forth for power plants are unusually good, only because builders and operators of stations neglect to consider in advance the fire-hazard problem or to call in competent advice.

A plant building may be readily constructed and machinery so arranged as to minimize fire risk and fire rate and not in any way prejudice convenience of operation, but distinctly lower fixed charges of all kinds.

The failure so to construct and operate may be largely ascribed to that same prevalent carelessness which until recently made depreciation accounts a rarity and entirely non-uniform. Depreciation has become largely standard as an itemized accounting of the time hazard. The itemized accounting of fire hazard must be recognized as no less important.

In gathering comparative fire data among lighting companies, to determine the justice of total fire rates and component charges, figures can be depended upon only when they include complete records for all plants over large territories and for many years. One year in one state among half the plants offers no basis for determining fire probability.

It is to be particularly noted that managements tend to belittle their fire losses when they become public and to suppress entirely data on small fires (which might have become big ones). This tendency makes true analysis of minor hazards difficult. It is not so much from a desire to avoid just insurance charges—there may even be no insurance carried—but the publication makes the local public distrust the reliability of service and stockholders blame a management as peculiarly careless when it may even be unusually attentive to fire prevention details. In this way other plant managements fail to profit by the bad fire experience of plants in their immediate neighborhood and sometimes of their own plant.

If electrical companies will collect absolutely thorough information even on incipient fires, which involves much closer investigation and more active co-operation from superintendent to boiler cleaner, a set of fire estimates might be evolved on which would be equitably based a low basis rate to cover the still unanalyzed hazard and a set of charges justly covering each fire hazard so determined, whether from construction, use or carelessness. Improvement following in these conditions would reduce uncomfortably large insurance charges and maintenance leaks would also be stopped.

As a matter of fact, the Underwriters have quite recently made strong efforts for this closer analysis and are applying over the central and western parts of the country a schedule with a basis of only 8 cents per $100 of insurance carried.

It is found by experience that those plants where all fire causes and fire damageability are carefully minimized are greatly benefited by the elimination of charges possible under this analytic schedule, whereas those plants where fire causes and susceptibilities are numerous will pay for such conditions a proportional contribution toward the total power-station fire loss of the country. Such a discrimination, determined by conditions, should receive the active support of all station managements. Present standards are briefly as follows:

1. Brick, stone or reinforced concrete walls and partitions 2 in. thick and increasing for height above 15 ft.

2. Partitions, floors and roof to be entirely non-combustible.

3. Roof and floor supports to be fireproofed to prevent warping from interior or exterior fires.

4. Lighting circuits to be in conduit. Station wiring to have non-combustible covering or be run in fireproof ducts.

5. Heating, if any, by steam, hot water or hot air.

6. No machine or woodworking or combustible supplies.

7. Switchboards non-combustible, oil switches, remote control and in fireproof room cut off from main station. Oil transformers similarly isolated and rooms drained.

8. Waste cans used for oily waste, metal lockers for extra clothing of men. Lubricating oils kept in metal cabinets or central oiling systems.

9. Sand pails, chemical extinguishers and public fire protection to be provided.

Where the station fails in any of the foregoing requirements the involved fire hazard is met with a proportional charge in insurance rate. These charges, again, are necessarily more or less interdependent. Combustible roof or floor will make otherwise negligible hazards assume considerable value. Even unprotected steel roof or floor supports have made almost complete fire losses by warping from heat of comparatively small station fires.

The station covering standard requirements will possibly have one chance in a thousand for complete destruction. Or, more clearly, out of 1000 equal valued standard stations the value of one will be wiped out in one or several fires somewhere among the 1000 plants each year. A minimum rate of 10 cents will cover these losses, or by further analysis, say, 8 cents on station and 15 cents on electrical contents, which are more damageable. From this point charges must be added for each fire hazard that is allowed to exist. If values subject to one fire increase, which will be the case in larger stations than the average, with combustible roofs or floors to carry fire, an area charge will equalize the contributory tax toward total loss among the 1000 stations.

If, however, only one-half the stations carry full insurance, the rest carrying from one-fourth to one-half and paying only that part of their total proportionate tax, the fire loss will remain the same and losses cannot be indemnified. Either all rates must be increased to meet such a condition or, more equitably, those stations paying less tax should pay higher rate of tax, since they are still indemnified for their average loss, the large ones being very rare, while paying a less than proper share toward the unchanged total of small losses. The latter method is employed by insurance men in power-plant schedule application. Instances might be multiplied, but the following station of $300,000 value illustrates hazards and rate analysis in a representative modern station for light and power:

	Present Condition.	Wood Floor and Roof Removed.
Basis with full insurance	.08	.08
1. Lack of parapets between wood-roofed divisions.	.03	...
2 Roof wood sheathing on steel trusses	.05	...
3. Unprotected steel trusses and columns	.02	.02
4. Area 30,000 sq. ft.	.22	...
5. Inflammable insulation on exposed wires	.05	.03
6. 44,000-volt oil switches and oil transformers	.07	.03
7. Boiler room communicates	.10	...
8. No metal lockers or waste cans	.05	.05
9. No protective devices	.10	.05
10. Exposure to ordinary windows from lumber yard at 10 ft.	.11	.11
Building and non-electrical contents	.88	.37
Electrical contents	1.02	.44

Most of the charges may be readily removed from the standard building by inexpensive improvements. Active investigation by operating companies will usually reveal a dozen forgotten or overlooked features of fire hazard due

to operation methods alone. Even construction defects may usually be removed with rate reductions which will pay good return on the investment, lower depreciation being considered. Power-station designers will find a very close relation between durability, convenience and low insurance.

With better methods employed by builders and operators the present wide diversity in minor defects, giving some excuse for errors of analysis application by non-engineer inspectors and adding seriously to insurance charges in any event, will be largely done away with.

Light and power companies having risks of simple fire-hazard analysis approaching standard will gain the attitude toward insurance companies now held by fortunate possessors of such plants, of appreciation for assistance toward economical operation, rather than of continual irritation at the collection by insurance companies of presumably exaggerated insurance taxes.

LETTER TO THE EDITOR.

Electrical Exhibit at Agricultural Fairs.

To the Editor of Electrical World:

SIR:—With the increasing attention paid to the farmer and his electrical needs by electric-service companies, and with the efforts of a large number of manufacturers to sell small isolated electric plants to farmers and owners of country estates, it is rather surprising that so few electrical concerns exhibit their wares at the various state fairs held throughout the country. It is true that a few electrical manufacturers do take advantage of the opportunity to show the farmer and the farmer's wife what utilities and conveniences they have to offer, but the number of concerns that are awake to this opportunity is surprisingly small. Many national and state associations of electrical men discuss the possibilities of electricity in the rural districts with much earnestness and elaboration, but the state fairs and perhaps other agricultural fairs and farmers' institutes offer an actual opportunity to "get next" to the farmer that appears to have been overlooked by electrical business men and operators, usually so alert.

Applied electricity should not be looked upon as a thing apart in American life. It is not to be considered as something available only in cities. Exhibit rooms are maintained by electric-service companies in many communities, large and small, and with good results. Why not, therefore, extend the idea to the state fairs, where the farmers go to learn the developments of the year? The American farmer is usually a sensible, intelligent man, with money to spend. He knows more about electrical development than the average electrical man thinks he does. He is getting around to the point where he is willing to consider the possible use of electric lighting and electric motors in his business. Furthermore, Mrs. Farmer is beginning to think there is no reason why she should not have electrical conveniences as well as the city woman—and there isn't.

Where available, the farmer will find it more convenient and satisfactory, and perhaps more economical, to use central-station service. But in many instances it is impracticable to turn to this source of supply, and in that case the ruralist is not to be taken out and shot at sunrise because he installs an isolated plant. The private plant may serve as an introduction to central-station service later. In the country, as in the city, the question of central-station supply versus private plant is to be fought out on its merits, in each case with a fair field and no favor. Now is a good time, when the possibilities of electrical application in the country are being realized dimly, for central-station men and isolated-plant advocates to show some mutual toleration and respect. Both groups should pay more attention to the introduction of electrical conveniences where none now exist than to the pleasing pastime of throwing rocks at the other fellows. It will be some time before the saturation point is reached in supplying the electrical needs of the three million square miles, more or less, of these United States.

Chicago, Ill. JAMES T. GORDON.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Rotor Hysteresis in Polyphase Induction Motors.—D. ROBERTSON.—The author first emphasizes that it is erroneous to assume that the hysteresis of the rotor iron in an induction motor is a cause of loss. Except for the high-frequency pulsations in the teeth, quite the reverse is true, and if the hysteresis could only be made large enough the rotor would run without slip, and consequently also without any rotor losses except those due to mechanical friction and to the pulsations just mentioned. On the other hand, the use of high-hysteresis materials will raise the tooth pulsation loss and, owing to the fact that these materials have necessarily a low permeability, increase the magnetizing current and corresponding stator resistance losses. The former effect will probably be small, as the hysteresis component of these pulsation losses in which the flux is not reversed will be small; and the latter effect becomes of importance only when the reluctance of the iron becomes comparable with that of the air-gap. An improvement in the performance of the motor is therefore to be expected by using high-hysteresis iron, especially if the rotor slots are closed or nearly so. The stampings for the stator should be of a low-loss, special-alloy steel brand, such as "stalloy," but those of the rotor should be of the cheapest brand. The rotor hysteresis produces a torque opposing relative motion of flux and rotor; the hysteresis torque is thus a driving torque at all speeds below synchronism and a retarding one at higher speeds. Its amount is practically constant, except at synchronism, when it may have any value not exceeding that just mentioned and may act in either way. Its production may be explained thus: If there were absolutely no resistance to its motion, the rotor would run at synchronous speed with its axis of magnetization coincident with that of the rotor field. When a small resistance is applied the rotor drops behind a little until the torque due to the relative displacement of these axes balances the load; it then runs at synchronism as before, but keeping this relative position of the two axes. With a greater load a larger displacement is required until the full hysteresis torque and maximum displacement are obtained. When the load is increased beyond this the rotor slips continuously and the balance of the necessary driving torque is obtained from the rotor currents. The axis of magnetization continues to rotate at synchronous speed, at a fixed distance behind the axis of excitation; owing to the relative motion of the flux axis and the material of the rotor, energy is now absorbed by the rotor hysteresis equal to the hysteresis torque multiplied by the slip speed. The power taken from the stator by the rotor hysteresis is equal to the same torque multiplied by the synchronous speed. The remainder, equal

to this torque multiplied by the speed of the rotor, is converted into mechanical power. The hysteresis torque is measured by the work done in rotor hysteresis per unit angular slip of flux and material; it is consequently constant for a given flux, as the energy converted into heat by hysteresis each cycle is independent of frequency. The power taken from the stator due to this cause is thus constant below synchronism and equal to that spent in rotor hysteresis when the rotor is at rest but the flux is the same. The author discusses the practical possibilities of a pure hysteresis motor and shows that there is no field for it except for certain special purposes where a self-starting synchronous motor of small output is required, such as is necessary in connection with certain laboratory measurements. Additional torque at synchronous speed can be obtained by having one large tooth per pole on the rotor, but this gives no assistance when starting or when the rotor begins to slip.—Lond. *Electrician*, Oct. 13.

Polyphase Commutator Machines.—F. Niethammer and E. Siegel.—The authors have formerly discussed the problem of the belt leakage of polyphase induction motors. They now discuss the upper harmonics of the fluxes in polyphase commutator motors. In the ordinary polyphase induction motor the fundamental waves of the primary ampere-turns and of the secondary ampere-turns always compensate each other, with the exception of those necessary for producing the useful flux, and this is true for any speed and any relative position of stator or rotor. The upper harmonics behave differently when the machine is at rest and when it is running. At rest they are directly added together, since they are revolving with equal speed, but when the motor revolves this is no longer the case. The authors show now that it is different with polyphase machines with commutator. The rotary ampere-turns produced by the rotor winding are independent of the speed, and each upper harmonic maintains its speed rotation at all speeds of the motor. The secondary ampere-turns behave just like the primary ampere-turns, and both are, therefore, directly added together at all speeds. The phenomena in the machine are the same at all speeds and comparable with those at a short-circuit of an induction motor at rest for a given position of its rotor. Just as the belt leakage can be changed in induction motors by changing the relative position of stator and rotor, so the same result can be obtained in the polyphase commutator motor by displacement of the brushes. The authors first deal with three-phase machines and then with two-phase machines.—*Elek. u. Masch.* (Vienna), Sept. 24.

Speed Regulation of Series Commutator Motors.—A note on a recent British patent (26,119, Oct. 5, 1911) of J. Gray (Latour). Each phase winding on the stator is permanently connected in series with the corresponding phase winding of a transformer, the secondary winding of which is taken to the brushes. By means of a two-way switch the stator windings can be star-connected for low speeds and for starting, and delta-connected for higher speeds.—Lond. *Elec. Eng'ing*, Oct. 12.

Frequency Transformers.—A note on a recent British patent (600, Sept. 21, 1911) of Brown, Boveri & Company. In one method of transferring power at one frequency from a primary set of mains to another set of mains at a different frequency two induction motors with slip rings are used, coupled to the same shaft. A stationary winding connected to two sets of brushes is also provided, either as a separate machine or on the same shaft as the induction motors. The stator of one of the latter is connected between the primary mains and its rotor to one set of these brushes, while the stator of the second motor and the other set of brushes are connected to the secondary mains, the rotor being short-circuited. The power supplied by one machine is transmitted to the mains at half the frequency, partly through the slip rings and partly by the machine acting as generator, the machines having the same number of poles and running at the same speed. The power can be varied by altering the excitation of the winding.—Lond. *Elec. Eng'ing*, Sept. 28.

Lamps and Lighting.

Incandescent Lamps When Operated at Varying Voltage.—J. Russner.—In order to separate the light radiation from the heat radiation, the author places an incandescent lamp without socket in a layer 30 mm thick of a 30 per cent solution of ferrous ammonium sulphate. This absorbs the heat rays almost completely, while it permits the light rays to pass with a loss of 15 per cent. As a result of the absorption of the heat rays the temperature of the solution increases. This increase of temperature is measured with a Beckmann thermometer. The incandescent lamp is then taken out of the solution and is enveloped with tinfoil blackened with lampblack on one side and is then placed again in the solution and lighted for the same length of time. In this case both the light and the heat rays are absorbed by the lampblack and changed into heat. The temperature of the solution increases now a little more. The difference in the increase of temperature in the first and in the second experiment is used by the author to separate the light radiation from the heat radiation. The author has made these

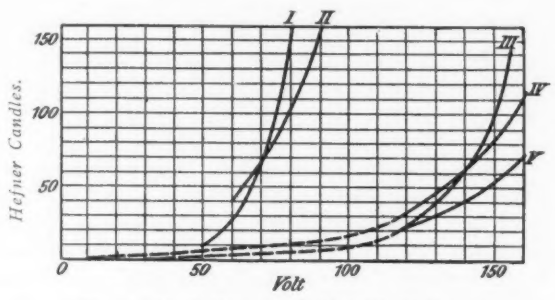


Fig. 1—Variation of Light with Voltage.

experiments with different voltages and found the following results: A 115-volt carbon lamp operated at 115 volts, 125 volts and 135 volts had an efficiency of 1.56, 2.2 and 3.1 per cent respectively. A 60-volt metallic-filament lamp operated at 60, 70 and 80 volts had an efficiency of 4.3, 5.3 and 6 per cent respectively. A 115-volt metallic-filament lamp when operated at 115, 125 and 135 volts had an efficiency of 4.5, 5.2 and 6 per cent. Efficiency is here defined as the ratio of the watts changed into light radiation to the total watts. The author has also measured the horizontal candle-power of incandescent lamps with increasing voltage, the results being given in Fig. 1. The abscissas give the voltage and the ordinates the hefner candles. Curve I refers to a 50-volt carbon lamp and curve III to a 115-volt carbon lamp. Curves II, IV and V refer to metallic-filament lamps. When the voltage is slowly raised with a carbon lamp the carbon filament comes up to a red heat simultaneously all over its length, which shows that little heat is conducted away from the two leading-in wires. It is different with various types of metallic-filament lamps, which begin to get red hot first in the center. This shows that considerable heat is lost through the leading-in wires.—*Elek. Zeit.*, Oct. 12.

Workshop Lighting.—W. Manktelow.—A long article on workshop lighting in which the author discusses the subject under the following headings: "Legislation and adequate illumination," "desirable illumination," "natural illumination," "artificial illumination," "general lighting" and "local lighting." He concludes "that a low local and a high and even general illumination should be provided, and all metal parts should, as far as possible, be covered with some dull paint: a dull white would be preferable from an illuminating point of view, but, for obvious reasons, a dull slate or green color is generally adopted." A lower illumination should really suffice at night than is required by day. That a much higher intensity actually appears neces-

sary in many cases is entirely due to uneven distribution and to too high local intensities. The author then takes up the personal factor in workshop lighting and gives figures for the illumination provided in actual workshops. Although such rules must be used with extreme caution, it may be taken that 1 mean spherical candle-power per 4 or 5 sq. ft. of floor area will give a suitable general illumination for most workships, while 1 mean spherical candle-power per 1 to 2 sq. ft. will, according to circumstances, give a sufficient additional "local" illumination.—Lond. *Elec. Review*, Oct. 6.

Filament Supports.—A note on a recent British patent (30,323, Oct. 5, 1911) of the British Thomson-Houston Company (General Electric Company of this country). The strength of filaments at their points of support is increased by this method of mounting. The copper leading-in wires are flattened and perforated at the ends, through which the filament is passed. It is then surrounded at this point by a helix of some tough material, such as drawn molybdenum, and the wires, filament and helix are welded together by an arc. The filament is supported at the curved end of the bulb by a similar helix, which is fused at one end into a glass support attached to the bulb. The filament is then slipped over one of the coils of the helix and mounted so that a certain amount of tension is exerted on the filament. Should this tension be too great it is adjusted during incandescence, as the heat communicated to the helix causes it to soften, and the coil adjoining the filament is drawn out.—Lond. *Elec. Eng'ing*, Oct. 12.

Carbon Lamp.—R. A. HOUSTOUN.—The continuation of his serial on studies in light production. The author deals with the carbon incandescent lamp and compares its behavior with that of a black body. He gives a summary of various determinations of efficiencies of carbon lamps and of the heat loss by conduction and convection.—Lond. *Electrician*, Oct. 13.

Generation, Transmission and Distribution.

Ontario Transmission System.—P. W. SOTHMANN AND J. TEICHMUELLER.—A long illustrated article on the 110,000-volt transmission system of Ontario, Canada, construction of the line and stations.—*Elek. Zeit.*, Sept. 28, Oct. 5 and 12.

Wireless Telegraphy.—A. BLONDEL.—An article on methods of detecting at the receiving station the direction from which a wireless telegram is received. These methods depend on the action of the electromagnetic waves on two antennas at the receiving station. Two different arrangements are possible according to whether the emfs in the two antennas are added one to the other or subtracted one from the other. Both arrangements are discussed with the aid of diagrams.—*La Lumière Elec.*, Oct. 7.

Traction.

Tramcar Meters.—R. G. AND J. G. CUNLIFFE.—A paper read before the (British) Municipal Tramways Association. The result of a long series of investigations into the relationship between energy consumption and maintenance costs carried out during the past few years at Manchester has been to demonstrate clearly that in the case of certain wearing parts of the equipments, in which the energy losses increase with wear, the economical life is determined by the energy loss rather than by the extent of the wear. In Fig. 1 curve *A* gives the units per car-mile, curve *B* the units per ton-mile, curve *C* the car-mileage run and curve *D* the average weight per car. Curves *A* and *B*, Fig. 2, show that the rate of energy consumption commenced to fall from the time that the methods were applied in 1908, the saving increasing as the equipments were gradually brought to a state of increased efficiency. The whole of the large increase in rate of energy consumption prior to 1907 was not due to the increasing inefficiency of the equipments, as the proportion of large double-truck cars in use was steadily increasing while the covering of cars was proceeding at a rapid rate, but curve *B* shows that the units per ton-mile also increased to a considerable extent and the effect of increasing weight ought to have been slightly to diminish this, since weight added to a car does not proportionately increase its rate of energy consumption, so that there was no doubt as to the importance of the increasing losses. From curve *C* it is evident also

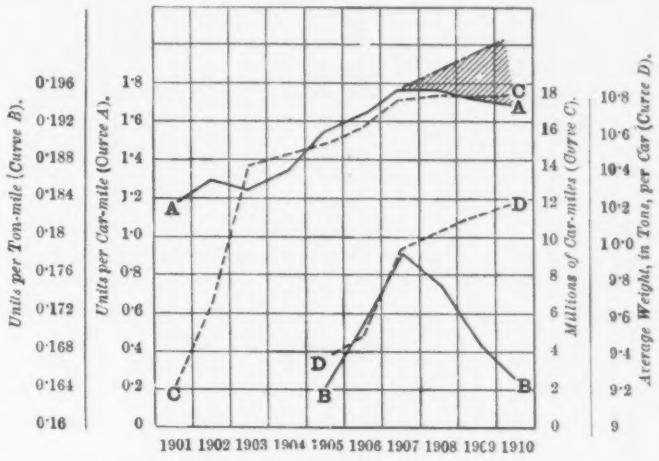


Fig. 2—Energy-Consumption Statistics.

that the mileage run was increasing rapidly and the transmission losses, being roughly proportional to the square of the mileage, were becoming of relatively greater importance. The actual saving effected is shown approximately by the shaded area in curve *A* and would have been greater but for the fact that the proportion of double-truck cars has continued to increase and the upper decks of many of the cars have been inclosed during the period under consideration, so that the average weight per car is much in excess of the 1907 value, as is shown by curve *D*. It is difficult to obtain an exact knowledge of either the value of the saving effected or the cost of obtaining it, but although the first cost of renewing faulty field coils, worm gearing, etc., and adopting a heavier gage of trolley wire where necessary was comparatively heavy, it has already been balanced by the saving in energy, which, in addition, is cumulative over a number of years, during which the increase in maintenance charges will be very slight. On the whole, by keeping down the losses it is possible to maintain the equipments in a better condition, with increased public safety and comfort, and, at the same time, to effect a saving, but this necessitates as exact a knowledge as possible of the values of the various losses, and one of the principal functions of the meters ought to be to supply this information. This, however, can only be done by meters capable of giving absolute values. The watt-hour meter gives complete information, the amp-hour meter partly complete information, while the information given by the time meter is incomplete. As an auxiliary meter the authors have developed a volt-hour meter. Concerning the different types of the meters for tramway use the authors reach the following final conclusions. The amp-hour meter can, with proper supervision, be made to operate with an accuracy within 1 per cent and its uncorrected values may be employed for the purpose of placing motormen and cars in their correct order of merit, while, when corrected for variation of average voltage by the volt-hour meter, its readings give the energy consumption. If percentage differences between the results of various men are required the corrected values must be used. The watt-hour meter, owing to its great complexity, more fragile construction, susceptibility to lightning discharges and greater inaccuracy, is not so desirable or valuable an instrument as is the corrected amp-hour meter. The time-meter, although very accurate in its measurement of time, cannot be trusted to measure energy within 10 per cent and,

if used at all, should be employed only in conjunction with the energy meter for purposes of investigation, in which connection it is very valuable. The volt-hour meter is indispensable for many purposes and ought to be employed on all tramway systems for the purpose of measuring average voltages. On small undertakings, with light traffic, approximately equal savings may be effected in the driving and in the detection of faulty equipments, but, as the congestion increases, the state of the equipments becomes of increasing importance, more especially as regards the feeding and distributing system, where the losses are a fraction of the total energy consumption and do not merely affect the consumption of individual cars. A copper voltameter for use on electric cars is described in an appendix to the paper.—Lond. *Electrician,* Oct. 6.

Electric Traction in Vienna.—An abstract of the financial report for the Vienna tramways for 1910. There were 271,584,931 passengers carried, as compared with 267,449,171 passengers in the year 1909. This represents an increase of 1.5 per cent, as compared with 9.1 per cent for the preceding year. This unfavorable result was due partly to an increase in fares and partly to poor weather. There were operated 49,822,147 car-miles, an increase of 5.84 per cent. The gross earnings were $8,565,330, an increase of 13.9 per cent. On the electrically operated lines of the system the operating expenses, exclusive of "welfare" work, constituted 60.9 per cent of the gross earnings, as compared with 61.1 per cent in 1909. The average earnings were 15.4 cents per car-mile, an increase of 7.6 per cent. The average receipts per passenger were 3.22 cents, compared with 2.90 cents in 1909. The total length of the system, measured as single track, was 312 miles. The 9786 employees of the company received $3,465,990 in 1910, an increase of 14.5 per cent over the year before. This sum was equivalent to 40 per cent of the gross earnings. In addition 6 per cent of the gross earnings was set aside for employees' welfare purposes, such as pensions and sick benefits. The use of car meters has produced a steady decline in the energy consumption per car-mile. In one case the clocks showed a difference of 68 per cent in the efficiency of two motormen who were operating under the same speed conditions over a given route. In another test it was found that a good motorman maintained the schedule for 312 days with 33,200 current-minutes, whereas a poor motorman required 55,070 current-minutes. Premiums for current-time saving were awarded to the amount of $11,525 for a total of 6433 cases. The improvement of the motormen is shown by the fact that 28 per cent received premiums in 1910 as compared with 15 per cent in 1909. The car meters on the cars are supplemented by clocks, which have been installed at forty-eight time points. These clocks have been found very effective in spurring the motormen on to maintain their schedules, in reducing energy consumption and in aiding statistical work, such as mileage determinations. At the end of the fiscal year there were 1201 motor cars and 1348 trailers in service. The latest rolling stock, numbering ninety-nine motor cars and 205 trailers, is of the vestibule type with separate passages for entrance and exit, as in the American pay-as-you-enter cars. These cars have reduced the length of stops by some 25 per cent. The new motor cars use interpole motors which are large enough to haul two trailers, and braking resistor grids are placed under the seats for use as heaters. —Lond. *Electrician,* Oct. 6.

Single-Phase Traction.—A. Soulier.—A long and profusely illustrated description of the single-phase traction system of the Haute-Vienne district in France. The total length of the lines is 345 km (207 miles) and comprises four lines all starting from Limoges. Use is made of single-phase current at 10,000 volts supplied from two stations, one a water-power station of 2400 hp at Eymoutiers and the other a steam station of 1000 hp at Limoges.—*L'Industrie Elec.,* Oct. 10.

Installations, Systems and Appliances.

Central-Station Statistics of Austria.—L. Rosenbaum.—An article in which the author gives further results of an analysis of the recently published central-station statistics of Austria. The approximate connections of all stations are as follows: For lighting, 230,500 kw; for motor service (including traction), 255,000 kw; total, 485,500 kw. The connections of incandescent lamps per capita and the yearly increase of the same per capita are smallest in cities of medium size (with 20,000 to 100,000 inhabitants). This is essentially due to the existence of gas plants in such cities. The connections of stationary motors per capita do not depend in general on the size of the city and on the existence of gas plants; their yearly increase is almost twice the increase of the lamp connections and amounts on the average to 30 per cent. The load factor increases in general with the size of the city; its average is below 15 per cent.—*Elek. u. Masch.* (Vienna), Oct. 1.

Electric Cooking Apparatus.—An illustrated description of electric cooking apparatus shown at the Olympia electrical exhibition in London. The essential feature of it is

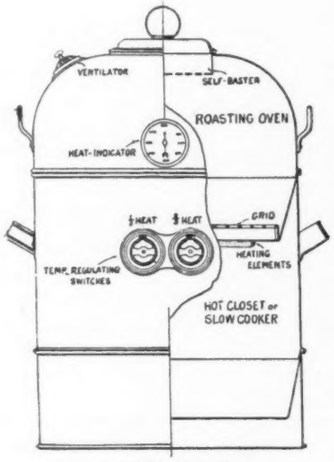


Fig. 3—"Electroyl" Oven, Part Section.

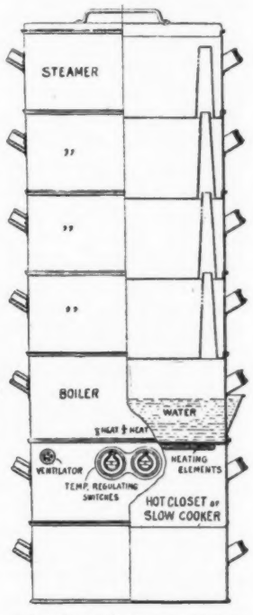


Fig. 4—"Electroyl" Steam Cooker, Part Section.

the arrangement of the heating element horizontally in the center of the oven, closely applied to the underside of a pan, as shown in the accompanying section, Fig. 3. The oven is made in three parts, forming two compartments; the upper is the roasting oven, and the lower, heated by radiation downward from the heater, is a hot closet or slow-baking oven. Access is gained to the upper compartment by lifting off the top section and to the lower one by lifting off two sections. The top section or cover is curved so as to assist the circulation of the hot air, and is provided with a self-baster—a perforated vessel in the top in which fat can be placed, which, melting, drips upon the joint below. A direct-reading temperature indicator is fixed on the top section, and by means of two switches three rates of heating are provided. It will be seen that the heating element is perfectly protected from falling moisture or fat, and from its position or shape it exposes the minimum surface to radiation sideways, while it is most effectively situated for radiation into the lower oven and for radiation and convection into the upper one. The oven is made of tinned steel, is light to handle and presents bright external and internal surfaces, so that radiation losses are reduced to a minimum. It is made in three sizes taking 800, 1000 and 1200 watts

at full load respectively, and the price is very low. A similar arrangement is employed in the steam cooker shown in Fig. 4. This consists of a pair of sections like the lower pair in the oven, upon which are piled a series of steamers to almost any number, as shown. Directly the water in the boiler reaches boiling point all the steamers are ready for use; on removing the boiling pan the top of the section containing the heating element can be used for frying, grilling, etc., with ordinary utensils. The steam cooker is also made in three sizes, from 800 to 1500 watts.—Supplement to Lond. *Elec. Review,* Oct. 6.

Electric Cooking.—R. B. MATTHEWS.—A long article on electric cooking, its present position and cost. The author first gives various tables and figures from actual practice showing that the loss due to shrinkage of meat is considerable with gas or coal heating while it is practically negligible with electric heating. This is considered not to be simply an advantage on paper but also to represent a considerable saving in the butcher's bill. Various data are given on the cost of electric cooking. The values given for the energy consumption approximate about ⅓ kw-hour per meal per person. Where gas costs 62 cents per 1000 cu. ft. and electricity is 2 cents per kw-hour the actual costs of cooking are about equal, while even at 3 cents per kw-hour electricity is cheaper than coal. Moreover, there are many other special advantages of electric cooking.—Lond. *Elec. Review,* Oct. 6.

Safety Device for Belt Drives.—F. C. MOINS.—A note describing a simple method of automatically stopping a motor should a belt break. Passing under a flywheel or driving belt is a cord (Fig. 5), one end secured to a

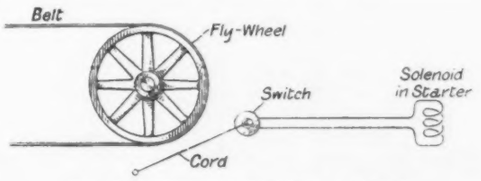


Fig. 5—Device for Stopping a Motor.

bracket and the other end secured to an ordinary 5-amp switch knob. From the switch two wires are run to the no-voltage release coil of the starter. When the strap breaks it fouls the string and closes the switch, which short-circuits the release coil of the starter and stops the motor. The author has found it of great value; moreover, it is quite inexpensive.—Lond. *Elec Eng'ing,* Oct. 12.

Electrochemistry and Batteries.

Dry Storage Battery.—A note on a recent British patent (28,755, Oct. 5, 1911) of G. Inrig and Gavan Inrig, Ltd. A dry storage battery, with no plates to buckle, is made up as follows: The positive electrode is a carbon block of star-shaped cross-section, fitted into the center of a block of depolarizing material. The electrode is separated from a zinc electrode of square section by a series of cane strips ⅛ in. square to allow for air circulation. In charging the cell contact is made with the zinc through the moisture absorbed by the cane strips from the electrolyte. As the charging proceeds a spongy deposit collects on the zinc and makes a permanent porous connection between the zinc and the electrolyte.—Lond. *Elec. Eng'ing,* Oct. 12.

Units, Measurements and Instruments.

Variable Condenser.—An illustrated description of a variable condenser exhibited at the Olympia electrical exhibition in London. It consists (Fig. 6) of a metal cylinder *A* fixed to an ebonite base *B* and covered with a thin sheet of mica, in contact with which is a layer of mercury *M* contained in the annular space between the mica and a glass cylinder *C*. The height of the layer of mercury is varied by squeezing a rubber bag *E* containing mercury, in communication with the annular space *D*, through a tube *F*. For this purpose a piston *H* is pressed down in a cylinder *G* by the screw *K L* and handwheel *N*. The capacity is, of course, proportional to the area of the mercury surface and therefore to

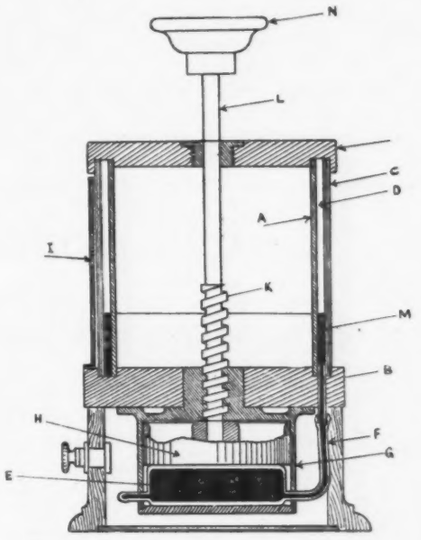


Fig. 6—Section of Mercury Condenser.

the height of the mercury, which is read off an index *I*. There is nothing to go wrong in the device; it will not spark over; it remains at the value it is set for without locking, and the same capacity is contained in a volume less than one-fourth of the usual type of variable air condensers.—Lond. *Elec. Review,* Oct. 13.

Instruments and Meters.—An illustrated description of various instruments and meters shown at the recent Olympian electrical exhibition in London. Among them are testing sets, a new alternating-current leakage recorder, a three-phase alternating-current ship's telegraph, a direct-current leakage recorder, a speed indicator, laboratory and switchboard instruments, an automatic transformer switch for auto-transformers for metallic-filament lamps (which has already been described in the Digest) and meters. The article is to be continued.—Lond. *Electrician,* Oct. 13.

Telegraphy, Telephony and Signals.

Anglo-Belgian Loaded Telephone Cable.—An article on the new telephone cable between England and Belgium. Special loaded coils have been introduced, which enable a superimposed or "phantom" circuit to be worked, in addition to two ordinary loop circuits. The constants of the cable are given as follows: Resistance per nautical mile of loop conductor = 14.2 ohms at 15 deg. C. without coils. Capacity per nautical mile of loop conductor = 0.157 mfd without coils. Capacity per nautical mile of phantom circuit without coils = 0.314 mfd. Self-inductance of the coils for the transformer circuit = 0.1 henry. Ohmic resistance of the inductive and non-inductive coils in the transformer circuit = 6.6 ohms. Effective resistance of the inductive and non-inductive coils of the transformer circuit at 800

$2\pi f =$	3,000	4,000	5,000	6,000	7,000
Transformer circuit.....	0.863	0.872	0.893	0.920	0.977
Phantom circuit.....	.....	0.877	0.904	0.928	.....

cycles with 1 milliampere at 15 deg. C. = 11.5 ohms. Self-inductance of the coils in the phantom circuit = 0.05 henry. Ohmic resistance of all coils in the phantom circuit = 3.3 ohms. Effective resistance of all the coils in the phantom circuit at 800 cycles with 1 milliampere at 15 deg. C. = 4.6 ohms. Capacity of the coils in the transformer circuit =

0.004 mfd. Additional capacity of the coils in the phantom circuit is less than 0.0001 mfd. The value of βl for 50 nautical miles, measured with the Franke machine, is shown on the preceding page.

It will be seen that the βl values are almost independent of the frequency. One week after the cable had been laid a fault occurred. It was found to be due to a bad joint between one of the cores and the insulation of the coils, and was repaired in twelve hours.—Lond. *Elec. Review*, Oct. 6.

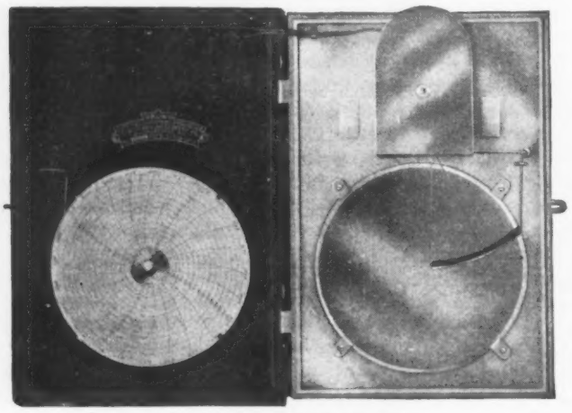
Rome.—J. Reyval.—The first part of an article on the different stations which supply the city of Rome in Italy with electric energy. To the end of 1910 these were four, namely, the water-power station of Tivoli of 5888 kw, the water-power station of Subiaco of 2944 kw, the steam station of San Paolo of 18,000 kw and the steam station of Tor di Quinto of 15,000 kw, the total power available at the end of 1910 being 28,332 kw. Since this was not sufficient, further power supplies have been made available, namely, the new water-power station of Arci of 2944 kw and the Terni water-power station of 22,000 kw. There are now 53,276 kw at Rome's disposal.— *La Lumière Elec.*, Oct. 7.

New Apparatus and Appliances

AN ELECTRIC RECORDING INSTRUMENT.

A new type of electric recording instrument particularly adaptable for use as a recording voltmeter or ammeter has been designed by the Brown Instrument Company and the Keystone Electrical Instrument Company of Philadelphia, Pa. Recognizing the necessity of a recording instrument which is both accurate in operation and simple in construction, much time has been spent in designing an instrument which can be mounted on the wall or switchboard and used by the most inexperienced workman.

In the common form of recording instruments no means are provided for shifting the recording pen arm out of the way when the chart which receives the record is changed; consequently there is serious danger of bending the pen in removing the chart. In this respect the new recording instrument is novel in construction, in that the essential parts of the instrument are mounted on the door instead of in the case, the clock mechanism and chart alone remaining in the case when the door is opened. Consequently there is no possibility of bending the pen because there is no occasion to handle it for any reason whatsoever. As soon as the door is thrown open the entire voltmeter system and the inking device is swung aside automatically, permitting the old chart to be easily removed and a new one substituted.



Interior View of Instrument.

The illustration above shows the instrument with the door thrown open ready to have a new record chart installed. The millivoltmeter system which is used in the instrument is a simplified form of the D'Arsonval system, universally used in electrical instruments of precision. The recording pen comes in contact with the paper momentarily only for the purpose of making a dot, thereby eliminating all friction between the pen and the chart. An inking pad is placed immediately beside the pen carrying sufficient ink for a week's supply, and this pad touches the pen point frequently, keeping it damp. When the door is closed the arm seen at the left in the cut and operating by the clock mechanism comes in contact automatically with the inking device, and every half minute, or quarter minute if preferred, it pushes the inking pad away from the pen, permitting it to swing freely. It then falls, allowing the inking pad by its own weight to press the recording pen against the paper.

MAGNETIC CHUCK.

In machine shop work one of the best labor savers among the numerous electrical devices is the magnetic chuck. It possesses a wide range of usefulness chiefly in holding pieces of work on the grinder, shaper and milling machine in preference to the older methods of clamping or bolting. In the chucks placed on the market by the D & W Fuse Company, Providence, R. I., the magnet coils are practically indestructible from overheating, as they are wound with deltabeston wire, a heatproof insulation of asbestos, and are designed so that should they become accidentally injured they can be removed by a workman and a new coil inserted. Chucks are made for surface grinding, planing and milling or for ring and cup grinding. The general design of stationary flat chucks for light work is shown in Fig. 1. The rotary chuck and chuck plate are shown in Fig. 2. By means of the chuck plate one chuck can be made to cover a wide range of operation in the grinding of rings, ball races, etc., as any number of plates can be used with a given chuck. The chucks are oilproof and waterproof and are fitted with a demagnetizing switch for easily releasing the work. Other magnetic chucks are also built by the company.

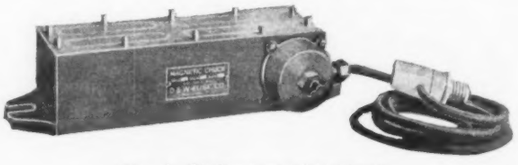


Fig. 1—Stationary Flat Chuck.

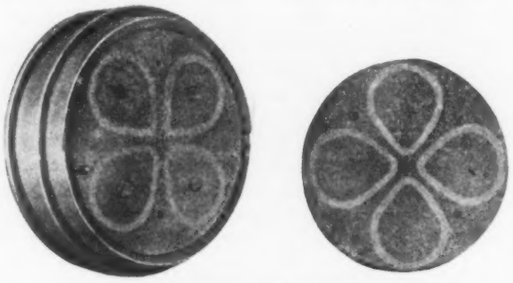


Fig. 2—Rotary Chuck and Chuck Plate.

SHADE-HOLDER TYPE OF INCANDESCENT LAMP DIMMER.

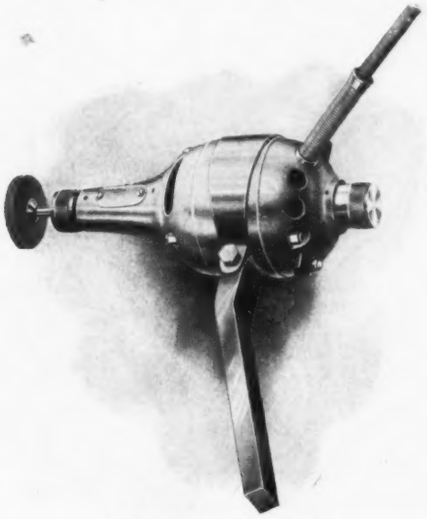
The form of "Dim-a-lite" illustrated, made by the Wirt Electric Specialty Company, Philadelphia, represents an interesting addition to this company's line of incandescent lamp dimmers, as it may be operated by simply turning the shade of the lamp. The dimmer is particularly adapted to

Dimmer Operated by Turning the Shade.

a bracket or portable light and will fit any electric fixture. It gives five gradations of light—"full," "dim," "low," "night light" and "out." The device can be easily attached in a few seconds and is stated to be very suitable for the metal-filament lamps. The appearance is neat, and an extra depth to the shadeholder gives sufficient "skirt" to bring the light well within the shade for the sake of "eye comfort."

PORTABLE ELECTRIC GRINDER.

Illustrated herewith is a new portable electric grinder made by the Hamilton-Beach Manufacturing Company, of Racine, Wis., intended for use in machine-shop practice for grinding dies, reamers, cutters, etc. The motor is of 1/12-hp and is of the universal type, operating on either



Portable Electric Grinder.

direct-current or alternating-current circuits at from 104 to 125 volts, and at 60 cycles in case of alternating current. The motor has been carefully designed for this special work and runs at a speed of 10,000 r.p.m. under light load and about 7000 r.p.m. when making a heavy cut. It is said that the only practical way to work up tempered-tool-steel tools is to grind them, and it is impossible to do this in many cases without a portable grinder. The machine illustrated weighs 5 lb. and the outer casings are made of aluminum. It has dust-proof bearings and the armature shaft is ground on centers to a mirror finish. The motor is air-cooled and is provided with adjustable end thrust and bearing. A shank is provided by which the motor is attached to the tool-post of the lathe, miller or other machine tool with which it may be used. Ten feet of cord and an attachment plug are also provided. Any kind of abrading wheel may be attached to the shaft, and felt or oiled-stone wheels may be used when a very fine finish is desired. The advantages claimed for this machine are the speed and efficiency of the motor and the lightness and convenience of the tool as a whole.

ART-GLASS FIXTURES OF HARD WOOD.

A new type of art-glass fixture, which is being marketed by the Rockford Light Furniture Company, of Rockford, Ill., makes use of a patented hard-wood construction, replacing the usual metal and lead beading. The strips framing the glass are made up of several layers of white basswood with cross-grained whitewood, and the whole is covered with a surface veneer of any ornamental hard wood desired. All parts of the framing are put together with screws. The glass is also held in position under screws and washers, but by an ingenious arrangement the smaller lower panes are set directly between layers of the five-ply framing itself. The handsome appearance of these wood fixtures lends an effect of quiet beauty and dignity not obtained with the usual materials from which such portable and shower fixtures are made. The wood fixtures are supplied in sixty different patterns, with any hard-wood finish desired. They are shipped knocked down in compact form, the shade with its threaded socket being screwed on to the standard when assembling. In case any pane of glass becomes broken it can easily be replaced by loosening the screws and inserting the new piece.

Portable Table Lamp of Hard Wood.

A NEW DIRECT-TYPE CRUDE-OIL ENGINE.

Many refinements of design, tending toward simplicity, convenience and economy of operation, mark the new Atlas crude-oil engine, which is of the Diesel internal-combustion type and so shares all of the well-known and remarkable efficiencies of this gradual-combustion principle. Efficiencies five times that of the ordinary non-condensing steam plant and double that of the best gas-producer outfits are claimed as characteristics of Diesel-type operation, too well known to need further mention here.

In bringing out the new Atlas crude-oil engine the designers of the Atlas Engine Works, Indianapolis, have sought to produce a prime mover which, while embodying all the remarkable efficiencies of operation of the earlier models of the Diesel principle, shall meet the practical needs of operation by its accessibility, convenience and simplicity of design wherever possible.

Among the points accomplished in this direction the following may be noted from an examination of the new Atlas engine: The valve heads carrying all the valve mechanism may be lifted off without disturbing the valve settings or mechanism. The cylinders are provided with liners of close-grained iron, separate from the casting and jacket, so that in case of wear the liners can be replaced cheaply, saving reboring and new pistons. The pistons are made of a similar hard iron, with slightly softer rings. The machine work on these cylinders and piston parts is done to an accuracy of 1/1000 inch, as is characteristic of the fine fitting of engines of this type. The relief valves with which the cylinders are provided also serve as inspection ports, through which the cylinder interiors may be examined. The crank cases, filled with a mixture of oil and water, are accessible through openings in the frame, by which all interior parts can be reached from the outside. Tension bolts joining the cylinder castings and base relieve the frame of mechanical strains and render it rigid in compression. The exhaust valves are cooled both internally and externally. The cooling water which has circulated in the valve recesses is then led out and into the exhaust pipe, where it is sprayed against the exhaust cage, also undergoing evaporation and cooling the exhaust gases.

The governor, which is of the fly-ball type, controls the first stage of the fuel injection pump, which works against no pressure, simply delivering the fuel in proportionate quantities to the second-stage pump. The latter operates at constant stroke, forcing the fuel oil at the rate received into the air jet at 900 lb. pressure. This is then fed into the highly compressed and overheated air in the clearance space of the cylinder during about one-tenth of the working stroke. Throughout this brief but actual period—about one one-hundredth of a second—the fuel jet is ignited and burns steadily, maintaining the initial compression pressure of 500 lb. After the first tenth of the working stroke the fuel is cut off and the gas expands adiabatically. On the next up-stroke the burned gases are expelled; during the following down-stroke fresh free air is drawn into the cylinder and the next up-stroke serves to compress this air to about 500 lb. pressure, heating it to 1000 deg. Fahr.

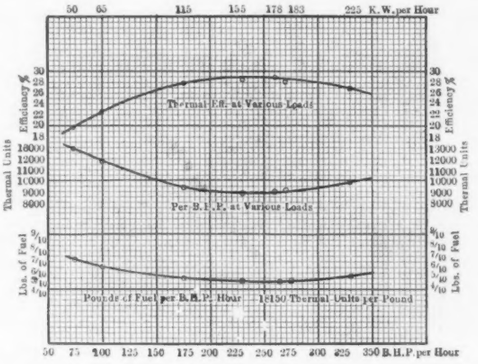

K.W. per Hour
Efficiency %
Thermal Units
Thermal Efficiency at Various Loads
Per B.H.P. at Various Loads
Lbs. of Fuel
Pounds of Fuel per B.H.P. Hour — 18150 Thermal Units per Pound
B.H.P. per Hour

Fig. 2—Efficiency and Fuel Consumption Curves Based on Test Results.

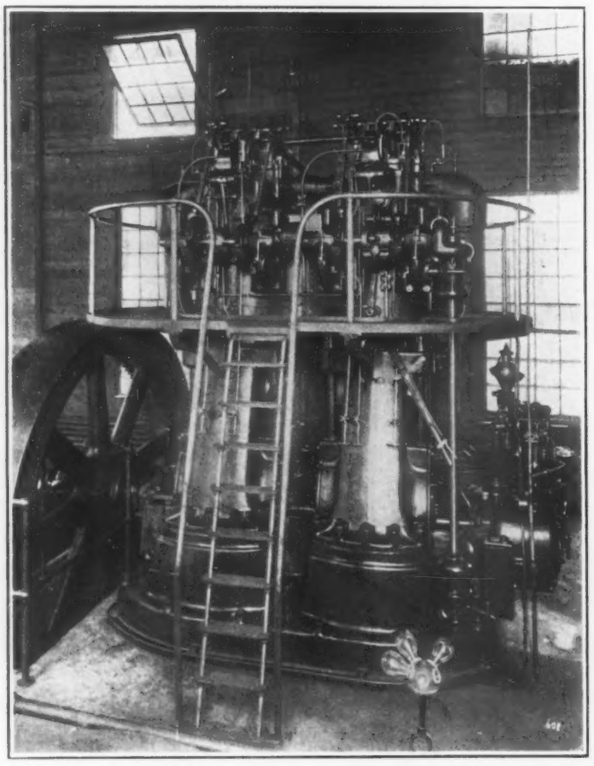


Fig. 1—300-Brake-hp Atlas Crude-Oil Engine.

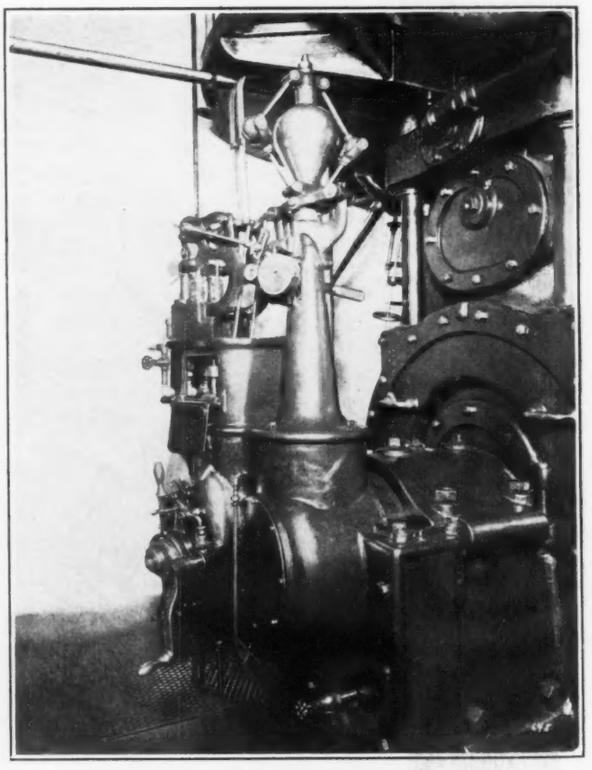


Fig. 3—Governor Mechanism and Fuel Pumps.

The four-cycle series is thus completed. The shaft from which the admission and exhaust valves are separately operated by rocker arms is itself driven through an intermediate vertical shaft and bevel-gear reduction from the main shaft.

The cheapest oil available at the nearest refinery or tank station can, it is stated, be used successfully in these new

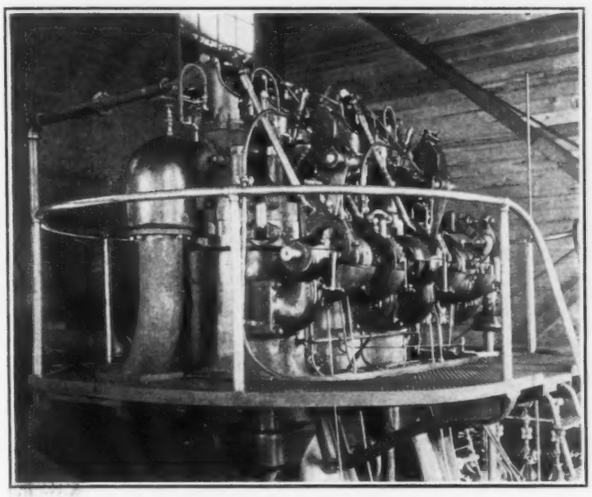


Fig. 4—Valve Mechanism of Engine.

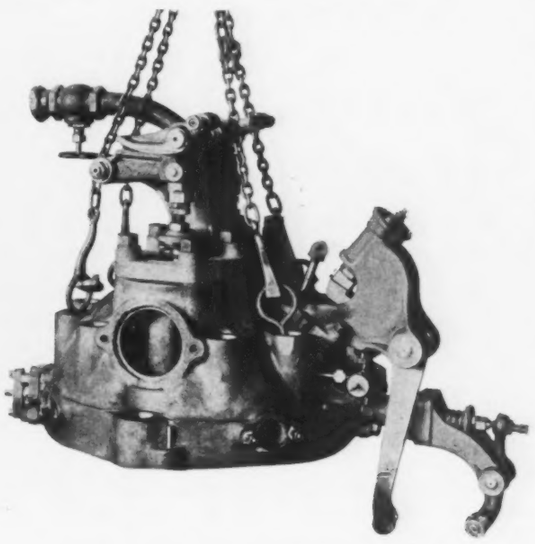


Fig. 5—Valve Head Lifted from Cylinder.

engines. Fluidity sufficient to be handled by a pump appears to be about the only requirement for the fuel. Such oil, containing 19,000 lb.-Fahrenheit heat units per pound (as all petroleum products do, practically independent of their quality), can now be purchased for 2 cents a gallon, more or less, depending on location. Since the Atlas engine produces a brake hp-hour on less than ½ lb. of oil, the fuel expense of operating a 100-kw plant would be hardly $2 per day. The advantage of handling fuel oil compared with coal needs no detailed analysis here.

Tests made on the Atlas Diesel-type engine show that its efficiency is practically as good at half load as at full load, reaching the highest point at about 80 per cent load. These engines are capable of 20 per cent overload without significant loss in speed. When severely overloaded, however, unlike the ordinary explosion-type combustion engine, they do not labor and halt, but simply fall off in speed like an overloaded steam engine. The thermal efficiency of the Atlas engine, based upon the indicator diagram, is 37½ per cent and on the brake horse-power developed 30 per cent. Its mechanical efficiency is hence about 80 per cent, 11 per cent or more going to the compressor.

Comparing Atlas oil-engine operation, using 19,000-heat-unit oil, costing 2 cents per gallon, with a simple Corliss steam plant burning 12,150-unit coal, costing $3.50 per ton, the manufacturers compute an annual saving of 80 per cent. Assuming, as seems reasonable, that the starting and light-load inefficiencies, costs of handling coal, additional labor, etc., will equal the entire fuel cost for the oil engine, the manufacturers estimate that the latter will pay for itself in fuel savings in four years, or proportionately sooner if operated more than sixty hours per week. On producer-plant operation a saving of 46.4 per cent is claimed.

A series of exhaustion, endurance and economy tests have been conducted on a 300-brake-hp, two-cylinder engine at the Indianapolis factory. Continuous service runs, 168 hours per week, without stopping, followed by 144-hour runs, allowing the engine to cool twenty-four hours to detect effects of rapid starting when cold, etc., have revealed no perceptible wear on bearing surfaces, no repairs and no adjustments beyond the ordinary ones with the engine in motion.

SUMMARY OF TESTS ON 300-HP ATLAS OIL ENGINE.

Date of run	6-21-11	6-20-11	6-20-11	6-19-11	6-21-11	6-20-11	6-21-11
Duration of test in hours	1.	1.5	3.	2.	2.5	4.	1.
Load in kilowatts by switchboard meter	67.	83.3	132.	173.5	200.4	205.75	249.
Kilowatts to compressor by wattmeter	24.75	22.66	23.6	25.5	29.6	29.25	31.
Transmission losses to compressors, 23.6 per cent	5.84	5.34	5.5	6.	6.98	6.91	7.31
Net kilowatts used by compressor	18.91	17.32	18.1	19.5	22.62	22.35	23.69
Brake horse-power used by compressor	25.32	23.20	24.25	26.13	30.31	29.94	31.74
Net kilowatts delivered to line	48.09	65.98	113.9	154.	177.78	183.4	225.31
Net estimated horse-power	64.44	88.41	152.62	206.36	238.22	245.75	301.91
Generator efficiency, per cent manufacturers' rating	87.	88.	89.	90.	91.	91.3	91.
Net brake horse-power	74.	100.4	171.4	229.2	261.7	269.4	331.7
Revolutions of engine per minute	174.7	174.1	173.13	173.1	172.9	171.9	171.
Fuel oil used, pounds per hour	50.	61.3	81.	108.	120.4	128.	167.
Pounds oil per kw-hour	1.04	.93	.71	.7	.68	.7	.74
Gallons oil per 100 kw-hours	14.22	12.73	9.73	9.6	9.27	9.55	10.15
Pounds of oil per brake hp-hour	.67	.61	.472	.47	.46	.476	.503
Gallons of oil per 100 brake hp-hours	9.18	8.36	6.47	6.44	6.3	6.51	6.9
Thermal units per brake hp-hour	12829.	11680.	9038.	9000.	8808.	9115.	9632.
Thermal efficiency of engine, 2545 thermal units per brake hp	19.8	21.7	28.15	28.27	28.9	28.	26.4
Fuel cost of 100 kw-hours in cents, oil at 2 cents per gallon	28.44	25.46	19.46	19.2	18.54	19.1	20.3

The accompanying table shows a summary of results from tests on this unit made by Mr. C. E. Sargent, M.E., an authority on internal-combustion engines.

The Atlas crude-oil engine is built in three sizes: Two-cylinder, 300-brake-hp; three-cylinder, 450-brake-hp; and four-cylinder, 600-brake-hp.

Industrial and Commercial News

The Week in Trade.

FILING of the federal suit seeking dissolution of the United States Steel Corporation on the ground that it is a monopoly in restraint of trade in violation of the Sherman anti-trust law forms the leading item of interest in business circles. Protest that the time for bringing the suit is inopportune, since arraignment of the leading industrial enterprise of the country injects further hindrance in the path of trade revival, is gradually losing its force. There now seems to be a widespread realization that, since the suit was certain to be brought, the sooner the status of the corporation is made clear the more rapidly will trade respond. As a matter of fact, the first shock is passing away, and there is far less anxiety exhibited toward the outcome than was shown in the Standard Oil and American Tobacco suits. There is every reason to believe that the Steel Corporation will be able to refute nearly all of the charges when the case is brought to trial and that no general reorganization such as was ordered in the foregoing cases will be required. That the iron and steel trades are not reflecting the pessimism found elsewhere is shown in the quarterly report of the Steel Corporation, covering earnings for the three months ended Sept. 30, which were better than in any quarter since the corresponding quarter last year. Net earnings were $29,522,725, as compared with $28,108,520 for the second quarter and $25,990,978 in the last quarter of 1910. Orders for railroad equipment, especially for cars, have been larger than those in several weeks, and it is expected that these will be still further increased before long. Demand for pig-iron is improving, and many consumers are expressing a willingness to close contracts for the future at prevailing rates. There is decided advancement shown in the wool trade, and New England mills are expanding their operations. Uncertain prices in the cotton markets are prompting buyers to hold off for the present, and there is little disposition in evidence toward closing contracts extending very far into the future. Business failures for the week ended Oct. 26, as reported by *Bradstreet's*, were 231, as compared with 258 last week, 220 for the corresponding week in 1910, 217 in 1909, 241 in 1908 and 223 in 1907.

The Copper Market.

COPPER prices continue to fluctuate between narrow limits, and in spite of a mild tendency toward advancement last week electrolytic is obtainable at 12.30 cents to 12.35 cents cash, although the larger agencies are still quoting 12.50 cents. Slightly lower prices than the foregoing are being asked by second hands. European quotations on electrolytic are between £57 and £57 5s. Standard copper in New York shows little change from the dullness of recent weeks, and all positions from spot to January inclusive have averaged 12.20 cents with 12 cents bid. Approach of the October report of the Copper Producers' Association is influencing purchasers to withhold as much as possible, pending confirmation of their views that stocks will be increased and that low prices will continue. The foreign attitude toward copper purchasing offers little encouragement to producers, and as the temporary setback in industrial conditions due to the suit against the Steel Corporation is almost certain to result in further dullness in the copper trade the outlook for disposing of large amounts of the metal in the immediate future is not very alluring. Estimates on the October showing place domestic consumption at 50,000,000 lb., export deliveries at 50,000,000 lb. to 55,000,000 lb. and output at 130,000,000 lb., which indicates an increase of 20,000,000 lb. in surplus copper stocks. There is every reason to bear out the opinion that the copper market at this time is decidedly in the hands of the purchasing element, and that a substantial increase must take place in demand for copper before prices will show permanent improvement. Exports for the month of October, lacking one day, aggregate 21,330 tons, which compares with 24,008 tons in the same period in September. The daily call on the Metal Exchange Oct. 31 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.95	12.10	....
November	11.90	12.05	11.97½
December	11.90	12.05	11.97½
January	11.97½	12.15	12.05

The London market, October 31, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	55	7	6	55	8	9
Standard copper, futures	56	2	6	56	3	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.35			11.57½		
London, spot	£57	10	0	£53	7	6
London, futures	58	2	6	54	0	0
Best selected	61	10	0	57	5	0

Industrial and Commercial Notes.

Federal Light & Traction Company.—A recent statement shows that the Federal Light & Traction Company, 60 Broadway, New York, now operates public utilities supplying Aberdeen, Hoquiam and Cosmopolis, Wash. (Gray's Harbor Railway & Light Company); Sheridan, Wyo. (Sheridan Electric Light & Power Company, Sheridan County Electric Company); Albuquerque, N. M. (Albuquerque Gas, Electric Light & Power Company, Albuquerque Electric Power Company); Trinidad, Col. (Trinidad Electric Transmission, Railway & Gas Company). Also the electric railway, lighting and power and gas plant of Tucson, Ariz.; the electric railway, lighting and power plant of Las Vegas, N. M.; the electric lighting and power plants of Rawlins, Wyo., Montrose, Col., and Hobart, Okla., and the Springfield Railway & Light Company, which owns the stock of the Springfield Gas & Electric Company and the Springfield Traction Company, of Springfield, Mo. The plants supplying Aberdeen, Hoquiam, Cosmopolis, Sheridan, Albuquerque, Tucson, Las Vegas, Rawlins, Montrose and Hobart were acquired June 1, 1910; the Springfield plant was acquired in May of this year, and that of the Trinidad company (formerly the Colorado Railway, Light & Power Company) on Aug. 2. The plant of the Gray's Harbor Railway & Light Company has been increased 70 per cent; at Sheridan, Wyo. a 3000-kw generating plant (Sheridan County Electric Company) has been established 10 miles from the city near coal mines, and the generating plant at Albuquerque has been doubled. The net earnings of all the properties were $264,596 for the year ended June 1, 1910, and $625,337 for the year ended July 31, 1911. The latter figure includes net earnings of the Springfield and Trinidad properties.

Alberger Pump Orders.—The Alberger Pump Company, New York, recently received an order from the city of Worcester through George W. Stetson, its Boston representative, for three four-stage belt-driven turbine pumps, with a capacity of 1400 g.p.m. each, against a total head of 550 feet, and a guaranteed efficiency of 70 per cent, deliveries being required Sept. 5, 9 and 12, with a penalty for each day of delay. As a matter of fact the deliveries were made on Sept. 1, 8 and 12, thus in two cases anticipating the required dates. As illustrating the extent to which formality was set aside, the legal documents necessary to make a full binding contract were not received by the pump builders until after the pumps were shipped. Deliveries under a contract for dry-dock pumps have begun at the Navy Yard in Brooklyn. This is the largest order for centrifugal pumps ever given by the government to one contractor, and includes eleven 54-inch main pumps and seven 15-inch drainage pumps, with all the electric motors and control; valves and pipe connections.

Electrical Development on Canadian Pacific.—Water power rights on the Adams River, in British Columbia, capable of developing 100,000 hp have been secured by the Canadian Pacific Railway. It is thought that this is a preliminary step toward electrification of its mountain system.

Hamilton Gas & Electric Company.—The Hamilton Gas & Electric Company has filed a voluntary petition in bankruptcy in the United States District Court at Cincinnati, and W. A. Everson, secretary and general manager of the company, has been appointed temporary receiver until the company and the bondholders can get together and unite upon a receiver or trustee. The liabilities are given as $1,013,856.36, while the appraised assets are $536,603.21. No valuation has been placed upon the perpetual franchise nor the entire stock of the Hamilton Otto Coke Company which the company owns. These are left open for appraisement. Attorney Robert Ramsey, who represents the company and is financially interested in it, states that the figures which appear in the schedule of liabilities should not be considered upon their face value, as the company has practically no assets except from some personal loans advanced by those closely connected with it to tide over troubles. On the other hand, the assets could not be valued in dollars and cents, he says. The franchise is of great value, as well as the stock of the Hamilton Otto Coke Company. Mr. Ramsey stated that the unequal competition brought about by the city's municipal gas plant caused the trouble. Plans have been under way for some time that, if consummated, might have relieved the trouble and prevented the company from going into the bankruptcy court, but a few bondholders who did not receive their interest when due last July had brought suit to recover on their coupons, and, as the officials felt that all should be treated alike, it was for this reason that the petition was filed.

Georgia Power Company.—The Georgia Power Company, through its chief engineer, C. O. Lenz, 71 Broadway, New York, has ordered from the General Electric Company transformers aggregating 33,500 kw in capacity to be installed in its substations as follows: At the Gainesville substation, 1500 kw; at Atlanta, 20,000 kw; at Newman, 3000 kw; at Cartersville, 6000 kw, and at Lindale 3000 kw. The high-tension side of these transformers will be wound for 110,000 or 55,000 volts, and the low-tension side for 22,000 or 11,000 volts. The order includes high and low tension switches, lightning arresters, etc. All of the high-tension apparatus and buses, except oil switches, will be placed out of doors. Small shelters, probably of concrete, will be provided for the oil switches. The Georgia Railway & Power Company, which was recently incorporated to acquire numerous hydroelectric properties in Atlanta, Ga., and adjacent territory, including the water-power properties of the Georgia Power Company, has acquired the Savannah River Power Company, of Anderson, S. C. This company operates a power station at Greggs Shoals, Anderson County, S. C., which furnishes energy to Abbeville and Greenwood, S. C. A hearing on the application of the Georgia Railway & Power Company to the Georgia Railroad Commission for authority to issue $30,000,000 in bonds and $37,000,000 in stock is scheduled for Nov. 7 at Atlanta. Options have been secured on a number of properties in Georgia.

American Telephone & Telegraph Statement.—The report of the American Telephone & Telegraph Company to the New York Stock Exchange as of Sept. 30, 1911, shows the following assets: Construction, equipment and supplies, $47,611,218; telephone instruments, $12,311,702; real estate, $2,188,239; stocks and bonds, $367,310,332; treasury bonds, $5,000,000; loans to telephone companies, $25,760,270; special demand notes, $31,898,262; cash and deposits, $14,142,278; accounts receivable, $7,995,489; total, $514,217,795. Liabilities: Capital stock, $275,000,800; capital stock instalments, $991,625; collateral trust bonds, $78,000,000; convertible bonds, $22,025,000; coupon notes, $15,000; accrued interest, $1,067,079; taxes, $416,755; unearned revenue, $2,786; notes payable to Western Union Telegraph Company, due 1912-15, $16,500,000; notes payable to subsidiary companies, $14,245,000; dividends payable Oct. 16, $5,519,816; other accounts payable, $1,349,396; reserve for depreciation, $37,581,970; surplus, $56,338,446; revenue balance, $4,174,117; total, $514,217,795.

Westinghouse Electric & Manufacturing Company.—Notice has been given to holders of assenting stock of the Westinghouse Electric & Manufacturing Company that the name of this stock has been changed to "common stock." This change in name involves no change in the stockholders' rights, and was made because all the outstanding stock of the company, other than the preferred stock, consists of the so-called "assenting stock," so that this stock is in fact, as it should be in name, common stock. New stock certificates have been prepared and will be exchanged on presentation of old certificates at the Union Trust Company, Pittsbugh, Pa., the United States Mortgage & Trust Company, New York City, and the New England Trust Company, Boston, Mass.

Dr. Pearson Finances $25,000,000 Power Company to Operate in Spain.—The Barcelona Company has been organized under Canadian laws with a capitalization of $25,000,000 to construct and operate hydroelectric plants and traction lines in the city of Barcelona and the entire northeastern section of Spain. Dr. F. S. Pearson, the active head of the syndicate controlling the Rio de Janeiro Tramway, Light & Power Company, the Sao Paulo Tramway, Light & Power Company and the Mexico Tramways Company, is financing the project. Generating stations aggregating 250,000 hp are under consideration. The new company has acquired one of the tramways in Barcelona, and has concessions for suburban lines, on which work will begin at once. Its head office is at Toronto.

Oroville Electric Corporation.—According to J. W. Goodwin, of San Francisco, president of the Oroville Electric Corporation, his company has made preliminary plans to build a power station on the Feather River 40 miles north of Oroville, Cal., and to extend its distribution system through Oroville and Marysville into Sacramento. The Oro Electric Corporation, controlling the Oro Water, Light & Power Company, was organized in March, 1911, with a capital of $10,000,000, of which $7,500,000 is said to have been subscribed. Bonds to the amount of $10,000,000 were recently authorized, and $5,000,000 of these will be issued shortly.

Bosch Magneto Works.—The projected removal from Springfield, Mass., of the Bosch Magneto Company's works is prompted by the nearness of rendering works which make themselves obnoxious to operatives. The *Springfield Republican* editorially says that the rendering industry should be required to move to another location, leaving the vastly more valuable industry in its present location. The plant of the Bosch company is designed to employ eventually 3000 mechanics. "Springfield and Chicopee cannot afford to have the Bosch company pull up its stakes here," says the *Republican*.

October Incorporations.—Compilation by the *Journal of Commerce*, New York, shows that papers filed in the Eastern States during October for companies with an authorized capital of $1,000,000 or over, including increases in capital, represented a total of $124,220,000, an increase of $47,216,000 over September, and $30,525,000 as compared with October, 1910. Papers filed by other companies with an individual capital of $100,000 or over, including states other than those in the East, brought the month's total up to $187,178,500, as compared with $156,912,000 in September and $176,437,317 in October, 1910.

Oskaloosa Traction & Light Company Sold.—The Des Moines River Power Company, composed largely of Eastern capitalists, with whom A. C. Miller, of Des Moines, Ia., is associated, has purchased the Oskaloosa Traction & Light Company, of Oskaloosa, Ia. The purchasers will carry out the contracts of the old company, including the building of a distribution circuit to New Sharon, 12 miles north of Oskaloosa. Other plans of the Des Moines River Power Company include the building of a dam some 8 miles south of Oskaloosa for developing about 10,000 hp in the section.

H. M. Byllesby & Company to Build $5,000,000 Plant in Kentucky.—General George H. Harries, whose election to the presidency of the Louisville (Ky.) lighting companies was mentioned in these columns last week, has announced that H. M. Byllesby & Company, of Chicago, will shortly begin the erection of a large power station at Cumberland Falls, Ky. The cost of the plant is estimated at $5,000,000. It is intimated that energy will be transmitted to Knoxville, Nashville, Cincinnati and Louisville.

Telephone Merger Backed by English Capital.—John W. Garland, of Pittsburgh, is completing details for an independent telephone merger embracing New Jersey, Pennsylvania, Ohio, Indiana, West Virginia and a portion of Illinois. An English syndicate well supplied with funds is understood to be behind the merger.

Aluminum Notes and Prices.—The aluminum market as of October 31 was reported dull, with ingots for remelting quoted at 20@22 cents spot No. 1 the base for large ingots. Rods and wire were held at 31 cents, and sheets at 33 cents.

Winnipeg Electric Company Sold.—The E. R. Reece Engineering Company, an American concern, has purchased the holdings of the Winnipeg Electric Company, which operates in Winnipeg, Man., and vicinity.

Financial.

The Week in Wall Street.

STEEL shares declined in the closing days of last week as a result of the government suit filed late Thursday afternoon against the Steel Corporation, the common stock falling to 50 on large transactions, as against 58½ at the close on Thursday. Other securities declined slightly under the lead of the Steel shares, but a mild recovery took place throughout the list on Monday, followed by general advance on Tuesday, with Steel common quoted at 54⅞ at the close. Attorney-General Wickersham, at the first hearing on the reorganization plan of the American Tobacco Company in the United States Circuit Court on Monday, intimated that the government would accept the plan, provided certain modifications involving fed-

NEW YORK.

	Oct. 24.	Oct. 31.	Shares Sold.		Oct. 24.	Oct. 31.	Shares Sold.
All. Ch.....	3	3*	4,560	Int. Met., pf.	44½	42½*	300
All. Ch. pf...	11¼*	10½*	200	Mackay Cos..	85*	85	100
Amal. Cop...	53½	52¼	75,350	Mackay C.,pf.	73*	72½*	150
Am. D. T....	33⅛*	33⅛*		Man. Elev....	135*	134⅝	250
Am. Loco....	34	32⅞	1,900	Met. St. Ry..	15*	15*	
Am. Loco. pf.	102	103*	800	N.Y.&N.J.Tel.	139½*	139½*	
Am. Tel. & C.	78*	78*		Steel com....	59¾	54⅞	1,203,800
Am. T. & T..	134⅛	135	7,550	Steel, pfd....	109⅜	105⅝	37,635
B. R. T.....	74⅝	74¼	4,800	W. U. T....	78⅛	78½	6,602
Gen. Elec....	150⅜	148¾	2,900	West'h, com..	64	63	3,500
Int. Met.....	14¾	14¾	7,000	West'h, pfd..	115*	115*	

PHILADELPHIA.

	Oct. 24.	Oct. 31.		Oct. 24.	Oct. 31.
Am. Rys.....	43½	44*	Phila. R. T.....	23	22⅞
El. Co. of A.....	11⅞	11⅞	Phila. Elec.....	16½	16⅛
Elec. St. Bt'y.....	53¼	52	Phila. Trac.....	83⅞	83⅞*
Elec. St. Bt'y, pf...	30*	30*	Union Trac.....	51¼	50¾

CHICAGO.

	Oct. 24.	Oct. 31.		Oct. 24.	Oct. 31.
Chi. City Ry.....	186*	186*	Com. Edison.....	128¾	131
Chi. Elev. Rys.....	28⅞*	27*	Chi. Subway.....	1¼	1
Chi. Elev. Rys., pf..	93	92	Chi. Telephone.....	119½*	121*
Chi. Rs., Ser. 1.....	96½	96½*	Nat'l Car.....	104*	104*
Chi. Rs., Ser. 2.....	32¾	30¼	Nat'l Car, pf.....	118½	119*

BOSTON.

	Oct. 24.	Oct. 31.		Oct. 24.	Oct. 31.
Am. T. & T.....	135	135	Mex. Tel.....	4*	3½*
Cum. Tel.....	150½*	150½*	Mex. Tel., pf.....	6*	6½*
Edison	287	292	N. E. Tel.....	146*	144½
Gen. Elec.....	150¾*	147¼	W. T. & T.....	26¼	26¾
Mass. E. Ry.....	22¼	21	W. T. & T., pf.....	105⅜	105
Mass. E. Ry., pf....	95	93¾			

*Last price quoted.
Shares sold for the week Oct. 23 to Oct. 28.

eral supervision are agreed upon. He asked that the government be granted permission to intervene at any time within five years and restrain the further working of the plan in case it does not restore competition; that none of the companies into which the American Tobacco Company is to be divided be permitted to own stock in any of the other companies; that no two be allowed to have common officers or directors, nor be permitted to purchase through common agencies or effect business in any way other than as separate and distinct organizations. He suggested that the government would permit each company to control 40 per cent of the business in its respective field as a maximum. It seems probable that the government will approve the general scope of the plan and retain the right to supervise its workings for a period of five years. Trading in American Tobacco common on Tuesday resulted in an advance of 30 points. The stock market is quiet, waiting upon the outcome of the Tobacco case. Earnings of Western railroads show fair progress in gross, and railroad securities have been relatively firm in the market during the week. The local money market on Tuesday was very quiet, in spite of financing of November requirements. Rates Oct. 31 were: Call, 2@2½ per cent; ninety days, 3½@3¾ per cent. The quotations in the tables are those at the close Oct. 31.

Financial Notes.

Galveston-Houston Electric Company Preferred Stock Offering.—An offering of $300,000 6 per cent cumulative preferred stock of the Galveston-Houston Electric Company is being made at 93½ to yield 6.4 per cent. This company owns substantially all the preferred and common stocks of the Galveston Electric Company, the Houston Electric Company and the entire capital stock of the Galveston-Houston Electric Railway Company. The Galveston Electric Company does the entire electric railway business and a portion of the electric lighting business in Galveston, Tex.; the Houston Electric Company does the entire electric railway business in Houston, Tex., and the Galveston-Houston Electric Railway Company will own and operate 45 miles of interurban electric railway now practically completed between Galveston and Houston, which, it is expected, will be in full operation in November. The capitalization of the Galveston-Houston Electric Company consists of an authorized issue of $3,000,000 6 per cent cumulative preferred stock, of which $2,000,000 is outstanding and of which $300,000 is now offered; also an authorized issue of $4,000,000 common stock, paying dividends at the rate of 3 per cent per annum, of which $3,000,000 is outstanding. There are also authorized $2,000,000 coupon notes due 1914, of which $600,000 is outstanding, which bear interest at the rate of 6 per cent and are convertible into common stock at par. There is an authorized issue of $2,500,000 first mortgage 5 per cent gold bonds of the Galveston Electric Company, due 1940, of which $1,213,000 is outstanding; an authorized issue of $2,500,000 first mortgage 5 per cent gold bonds of the Houston Electric Company, due in 1925, of which $2,103,000 is outstanding, and an authorized issue of $5,000,000 first mortgage 5 per cent gold bonds of the Galveston-Houston Electric Railway Company, due 1954, of which $2,750,000 has been issued. Additional bonds of the Galveston Electric Company and Galveston-Houston Electric Railway Company can be issued only to the amount of 80 per cent of the actual cost of permanent additions and improvements to the property. All the Houston Electric Company bonds authorized have been issued, and $307,000 face value have been purchased for the sinking fund. Interest on the $2,750,000 Galveston-Houston Electric Railway bonds will be charged to "interest during construction" until the completion of the interurban line. These bonds are guaranteed as to principal, interest and sinking fund by the Galveston-Houston Electric Company. Gross earnings of the combined companies for the twelve months ending Aug. 31, 1911, were $1,447,726; operating expenses, $848,135; and net earnings, $599,591; interest charges and taxes were $246,363, leaving a balance of $353,227. The bond sinking fund amounted to $55,970, leaving a balance of $297,257 available for dividends on $2,300,000 preferred stock, the requirement for which, including that now offered, is $138,000. The Galveston property has been under the management of Stone & Webster since 1905, and the Houston property since 1900.

Public Utility Securities Listed on New York Exchange.—Applications to list the following securities have been approved by the governing committee of the New York Stock Exchange: Westinghouse Electric & Manufacturing Company, $36,738,900 common stock to be substituted on the list, on official notice of issuance, in exchange for a like amount of outstanding assenting stock; Public Service Corporation of New Jersey—$5,000,000 additional general-mortgage 5 per cent sinking-fund fifty-year coupon bonds, due 1959, which make the total amount listed to date $30,000,000; Pacific Gas & Electric Company—$5,401,000 California Gas & Electric Corporation unifying and refunding mortgage 5 per cent thirty-year bonds, due 1937. In addition to these, authority is given to add $860,000 of the bonds on official notice of sale and distribution, which places the total amount authorized to be listed at $20,151,000.

Detroit Edison Company to Increase Stock.—Stockholders of the Detroit Edison Company will meet in New York City Nov. 15 to vote upon an increase in capital stock from $9,000,000 to $15,000,000, the proceeds of which will be used to furnish funds for extensions and additions made necessary by the continual growth of the company's business. Of the present authorized $9,000,000 capital stock, $6,000,000 is outstanding, and $3,000,000 has been reserved against an equal amount of outstanding convertible debenture bonds. It is proposed to issue $1,500,000 of the new stock at an early date and this will be offered to the stockholders, pro rata, for subscription at par.

Milwaukee Electric Railway & Light Company.—The Wisconsin Railway Commission has authorized the Milwaukee Electric Railway & Light Company to issue $2,000,000 refunding and extension mortgage 4½ per cent bonds.

Maryland Electric Company.—The report of the Maryland Electric Company for the fiscal year ended June 30 1911, has been submitted to the Maryland Public Service Commission. The statement of the company shows operating re-

enue for the period of $211,812.68 and operating expenses of $207,749.93, leaving a net operating revenue of $4,062.75. Against this were charged outside operating expenses of $4,071.50, representing the money expended in the up-keep of the Bay Ridge resort, which was not in operation during the year. This left a total net deficit of $8.75. Other income received by the company during the fiscal year amounted to $216,790.58, made up as follows: $216,000, representing rents accrued for lease of road; $480.83, representing revenue from separately owned properties, the Annapolis Land & Improvement Company and the Maryland Land & Improvement Company; $309.75, representing income from sale of electric power. The deductions from this were as follows: $12,199.50, representing taxes accrued for the year; $8.75, the total net deficit from operation, as above; $1,500, rents accrued for the lease of other roads; $1,568.75 for hire of equipment; $11,776.14, joint facilities, and $2,250.60, miscellaneous rents. Other deductions included interest accrued on funded debt amounting to $252,145.80; other interest, $10,285, and extinguishment of discounts on securities, $20,460, the total deduction from the gross corporate income of the company being $299,966.29, representing a net corporate loss of $95,383.96. In the report as filed with the Public Service Commission no revenue expenses or taxes are shown from the operation of Bay Shore Park, for the reason that the property is leased to the United Railways & Electric Company under a general leasing agreement, and no specified amount of income is paid for the property, as the taxes and expenses are borne by the United Railways.

Montreal Street Railway's Year.—Earnings of the Montreal Street Railway Company in the year ended Sept. 30, 1911, to which reference was made in the previous issue, were the largest in the history of the company. Gross earnings were $4,775,301, as compared with $4,352,551 in 1910; expenses were $2,679,806, as compared with $2,455,301, and net earnings were $2,095,495, which compares with $1,897,250 in the year ended Sept. 30, 1910. Other income was $114,808, as compared with $85,878, making a total income of $2,210,303, which compares with $1,983,123 in the previous year. Charges, taxes, etc., were $583,904, as compared with $507,978, leaving a surplus available for dividends of $1,626,398, which compares with $1,475,150 in the preceding year and is equivalent to 16.26 per cent on $10,000,000 capital stock before deduction of insurance and contingent reserves. The earnings in the preceding year were equal to 14.75 per cent on the same stock. Dividends were $1,000,000, and insurance and contingent reserves were $275,000, leaving a surplus for the year of $351,398, which compares with $200,150 in the year preceding. E. A. Roberts, president of the company, in his report refers to the negotiations toward effecting an amalgamation with the Montreal Tramways Company, and to negotiations with the city of Montreal for the purpose of making a new contract that will be more applicable to present-day conditions than the present one, in view of the rapid growth and congestion of the city. He expresses the hope that amalgamation with the Montreal Tramways Company will help to complete speedily the negotiations for a new franchise.

Public Service Corporation of New Jersey.—The report of the Public Service Corporation of New Jersey and its subsidiary companies for the nine months ended Sept. 30, 1911, as filed with the New York Stock Exchange, shows the following: Gross earnings of operating companies, $21,975,080; income from miscellaneous sources, $1,391,455, making total earnings $23,366,536. Operating expenses and taxes were $12,111,211, and net earnings were $11,255,324. Fixed charges of the operating companies were $8,269,553, leaving a balance of $2,985,770. The fixed charges of the Public Service Corporation of New Jersey were $1,870,098. The combined surplus of the Public Service Corporation of New Jersey and the subsidiary companies was $1,115,672, which, with the previous surplus (plus adjustment) of $1,707,698, made a total surplus of $2,823,370. Dividends paid to Sept. 30, 1911, were $1,125,000, leaving a surplus of $1,698,370. Profit and loss of the subsidiary companies not taken upon the books of the Public Service Corporation of New Jersey was $718,020, and the balance to the credit of profit and loss Sept. 30, 1911, was $980,350. The general balance sheet of Sept. 30, 1911, showed as follows:—Assets: Investments at cost, $62,303,001; bonds in treasury, $5,000,000; advanced to Public Service Railway Company, $3,584,250; advanced to Public Service Electric Company, $1,505,162; cash, $631,527; cash to redeem gold notes, $4,000,000; accrued interest and rentals receivable, $835,160; accounts receivable, $44,173; advance payments, $414; deferred charges account of discount and commission on bonds and notes, $2,804,228; total, $80,707,918. Liabilities: Capital stock, $25,000,000; gold bonds, $30,000,000; certificates, $19,970,440; gold notes, $4,000,000; accounts payable, $152,392; taxes, advance and accrued, $21,067; interest accrued, $456,668; reserve, $125,000; profit and loss, $980,350; total, $80,707,918.

Pacific Gas & Electric Company.—The consolidated balance sheet of the Pacific Gas & Electric Company, as of July 31, 1911, showed assets as follows: Plant and other property, $112,084,682; funds to future construction, $845,888; free treasury securities, $892,596 (market value in excess of $1,300,000); materials and supplies, $1,107,404; advances on contracts, $73,350; notes receivable, $8,037; consumers' accounts, $1,083,532; cash, $1,084,998; deferred and contingent assets, $1,789,638; bond discount and other deferred charges, $1,819,856; total $120,789,986. Liabilities: Common stock, $20,000,000; preferred stock, $10,000,000; bonds, $64,072,097; sub-company funds accrued, $1,028,068; consumers' deposits, $307,941; notes payable (since paid), $200,000; current obligations, $944,618; San Francisco rate-case funds due customers, $457,442; other liabilities, $172,739; insurance reserve, $341,451; uncollectible accounts reserve, $65,222; sinking-fund and depreciation reserve, $7,463,280; surplus, $15,559,146; total, $120,789,986.

Ontario Power Company.—The report of Ontario Power Company, of Niagara Falls, Ont., for the nine months ended Sept. 30, 1911, shows gross earnings of $622,443, operating expenses of $110,191, and net earnings of $512,251 for this period. Other income was $64,755, making a total income of $577,006. Interest charges were $504,293, leaving a surplus of $72,713.

Keystone Telephone Company.—Gross earnings of the Keystone Telephone Company of Philadelphia for the three months ended September 30 were $290,606, which compares with $282,809 for the corresponding period in 1910. Expenses and taxes were $148,885, leaving net earnings of $141,721, as compared with $141,587 in the three months ended September 30, 1910.

DIVIDENDS.

Detroit United Railways Company, quarterly, 1¼ per cent, payable Dec. 1.

Northern Texas Electric Company, quarterly, $1.50 per share, payable Dec. 1.

Pensacola Electric Company, semi-annual, preferred, $3 per share, payable Dec. 1.

Tampa Electric Company, quarterly, $2 per share, and an extra dividend of $1 per share, both payable Nov. 15.

REPORTS OF EARNINGS.

AMERICAN CITIES COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Sept., 1911.....	$1,125,412	$679,955	$445,457	$255,120	$190,337
Sept., 1910.....	1,062,989	642,802	420,187	241,594	178,593
12 m., Sept., '11..	13,146,319	7,386,519	5,259,800	3,008,862	2,250,938
12 m. Sept., '10..	12,437,190	7,513,023	4,924,167	2,916,031	2,008,136

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.

Sept., 1911.....	$626,425	$361,468	$264,957	$50,007	$214,950
Sept., 1910.....	575,272	319,772	255,500	49,038	206,462
9 m., Sept., '11...	5,436,126	3,218,060	2,218,066	458,362	1,759,704
9 m., Sept. '10...	5,436,126	2,879,889	2,198,804	434,974	1,763,829

MASSACHUSETTS ELECTRIC COMPANIES.

Qtr., Sept., '11...	$2,799,061	$1,560,208	$1,238,853	$472,969	$765,883
Qtr., Sept., '10...	2,741,764	1,434,626	1,307,138	459,512	847,625
12 m., Sept., '11..	8,938,815	5,682,884	3,255,931	1,851,786	1,404,144
12 m., Sept., '10..	8,560,949	5,360,295	3,200,654	1,792,936	1,407,717

NASHVILLE RAILWAY & LIGHT COMPANY.

Sept., 1911.....	$179,132	$98,312	$80,819	$39,294	$41,525
Sept., 1910.....	163,307	89,522	73,785	38,288	35,497
9 m., Sept., '11...	1,440,175	849,789	590,386	346,058	244,328
9 m., Sept., '10...	1,341,847	777,993	563,854	342,448	221,405

NORTHERN OHIO TRACTION & LIGHT COMPANY.

Sept., 1911.....	$246,015	$128,812	$117,203	$44,321	$72,882
Sept., 1910.....	224,901	117,857	107,044	43,391	63,653
9 m., Sept., '11...	2,019,746	1,110,504	909,242	399,069	510,172
9 m., Sept., '10...	1,837,406	1,009,858	827,548	390,161	437,387

General News

Construction News.

ANNISTON, ALA.—The officials of Blue Mountain City, a mill town on the outskirts of Anniston, have awarded a contract to the Anniston Electric & Gas Company to supply electricity for lighting the streets and residences of the city. The contract calls for the erection of twenty-five street lamps and lighting seventy residences.

BIRMINGHAM, ALA.—The Birmingham, Ensley & Bessemer Railroad Company, it is reported, is contemplating the erection of a power plant to supply electricity to operate an electric railway from East Lake to Ensley. The power house will be built to provide for future extensions.

KETCHIKAN, ALASKA.—The Granby Mining & Smelting Company, of British Columbia, has acquired a smelting plant near Ketchikan and is planning to build a hydroelectric power plant to supply electricity for operating the plant and mining machinery.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association has awarded the contract for the construction of power plant No. 2 on the South Consolidated Canal to Olsen & Graf, for $22,922.

FORSYTH, ARK.—Contracts for the construction of a 40-ft. reinforced concrete dam and power house for the Ozark Power & Water Company, to be located on the White River, 2 miles above Forsyth, have been awarded to the Ambursen Hydraulic Construction Company, 165 Broadway, New York, N. Y. The General Electric Company, of Schenectady, N. Y., secured the contract for three 1500-kw generators and waterwheels. Contracts for the erection of the transmission line from the power house to Springfield, Mo., a distance of 43 miles, have not yet been awarded. Holman & Laird, of St. Louis, Mo., are consulting engineers.

OSCEOLA, ARK.—The City Council has passed an ordinance creating an improvement district for the purpose of building and operating an electric-light plant in Osceola. This move was made necessary owing to the notification of Abner Driver, who has furnished electrical service to the city for fifteen years, that he would close down his plant Jan. 1, 1912.

ALHAMBRA, CAL.—The Board of Trustees is planning to install an ornamental street-lighting system on North Marguerita Street. Ornamental lamp standards, each carrying three lamps, will be erected.

BAKERSFIELD, CAL.—The Lost Hills Telephone & Telegraph Company is planning to build a new line in the Lost Hills oil-field district, to cost about $25,000. Richard Hastings is manager.

EL CENTRO, CAL.—Notice of appropriation has been filed by Frank M. Salisbury, of Imperial, and W. H. West, of Brawley, of 50,000 in. of water in the Alamo River, acting in behalf of a syndicate which proposes to build a dam across the Alamo River three-fourths of a mile east of the Alamo Bridge. The proposed dam will cost about $75,000 and will conserve water to irrigate 50,000 acres of land in the vicinity of Estelle and Rockwood.

EUREKA, CAL.—Negotiations have practically been closed whereby the Western States Gas & Electric Company will take over the Blue Lake light and power plant, owned and operated by the Minor Mill Lumber Company. With the purchase of the Blue Lake plant the Western States Gas & Electric Company has practically the entire control of the electric-light and power service in Humboldt County. The company has already taken over the light and power plants in Arcata, Fortuna and Ferndale.

FRESNO, CAL.—The San Joaquin Light & Power Company is reported to be contemplating the installation of electric pumping machinery on its property in the Caruthers district.

GLENDALE, CAL.—The city has decided to erect ornamental lamp standards, each carrying four lamps, on Fourth Street, Glendale Avenue and Grand Boulevard. Property owners will bear the expense. H. B. Lynch, manager of the municipal electric plant, is in charge of the work.

LINDSAY, CAL.—The Tulare Power Company is reported to have awarded a contract to the Hunt-Mirk Company, of San Francisco, Cal., for the erection of a power plant in Lindsay. The plant will be located on the Giannini ranch, just outside of the city limits, and will be equipped with steam turbines and have an output of 3000 hp. F. T. Billings is one of the directors.

LIVERMORE, CAL.—Preparations are being made by the Livermore Water & Power Company to extend its transmission lines from Pleasanton to Sunol, a distance of 5 miles.

LOS ANGELES, CAL.—It is reported that the Board of Public Works has extended the time for receiving bids for machinery for the municipal aqueduct power plant in San Francisquito Canyon from Oct. 23 to Nov. 10.

LOS ANGELES, CAL.—The Pacific Light & Power Corporation has awarded a contract to the Pelton Water Wheel Company for the installation of three Pelton-Francis turbines. The turbines will drive three 3000-kw generating units.

LOS ANGELES, CAL.—An electric power plant will be installed in the New Rosslyn Hotel, to be erected at Fifth and Main Streets by Hart Brothers, plans for which are being prepared by Parkinson & Bergstrom, architects, of Los Angeles, Cal.

OAKLAND, CAL.—Plans have been approved by the Southern Pacific Company for the erection of a concrete and steel power-storage plant at the Melrose terminal of the Seventh Street local, at a cost of $30,000. The lower floor will be used for storage of cars and the upper story will be used exclusively for storage batteries and generators. This station will receive energy from the Fruitvale plant.

OROVILLE, CAL.—Preparations are being made by the Oro Electric Corporation for extensive improvements and extensions to its system. The plans include the enlargement of the power plant of the Oro Water, Light & Power Company, a subsidiary, located near Oroville, the construction of a new power plant on the Feather River about 40 miles north of Oroville and extension of its transmission lines into Marysville, Sacramento and Oakland. Bonds to the amount of $10,000,000 were recently authorized by the company, of which $5,000,000 will be issued immediately. J. W. Goodwin is president of the company.

PASADENA, CAL.—The Nazarene University Park Company has applied for a twenty-year franchise to build an electric railway on Washington Street. The Pacific Electric Railway Company has refused to construct the line and the stockholders of the Nazarene company have voted to appropriate $32,000 to construct the road. J. W. Goodwin is president of the Nazarene company.

PERRIS, CAL.—The Board of Trustees has granted the Southern Sierras Power Company a franchise to erect a transmission line along the roads and city streets to supply electricity in Perris. It is expected to have the line completed by next April.

REDDING, CAL.—The Northern California Power Company has filed notice of diversion of 250,000 in. of water from the Pit River. The company proposes to build a large hydroelectric plant about 1 mile below the Big Bend Hot Springs with a total generating capacity of 120,000 hp. Three high-tension transmission lines carried on steel towers will be erected through the Sacramento Valley. The cost of the entire project is estimated at about $4,000,000.

RED BLUFF, CAL.—Notice of appropriation of 300,000 in. of water to be taken from the Sacramento River at the mouth of Resbank Creek, 3 miles below Red Bluff, has been filed by A. L. Collins, an engineer who has been connected with the Sierra & San Francisco Power Company. The water is to be used for irrigation purposes in Tehama, Colusa, and Yolo Counties.

SAN BERNARDINO, CAL.—The Southern Sierra Power Company has awarded the contract for the construction of its transmission line from Bishop to San Bernardino, a distance of about 240 miles, to T. C. Dobbins, of Los Angeles, Cal. The contract is for labor only and amounts to about $250,000. The company, it is reported, is planning to erect an auxiliary steam plant at Banning, Cal.

SAN JOSE, CAL.—The San José & Almaden Railway Company, recently incorporated with a capital stock of $120,000, is planning to build an electric railway from San José to New Almaden, a distance of about 12 miles, for which the company has been granted a franchise. C. A. Nones, C. P. Anderson and D. M. Burnett are interested in the company.

SARATOGA, CAL.—The Grand Lodge of Odd Fellows has awarded the contract for the construction of administration building, power house and outbuildings for the new Odd Fellows' Home to Williams Brothers & Henderson, Monadnock Block, San Francisco, Cal., for $118,786.

VISALIA, CAL.—The Mount Whitney Power Company has awarded a contract to the Pelton Water Wheel Company for a Pelton-Francis turbine to be installed in power house No. 2. The new wheel is rated at 2250 hp and will be direct-connected to a General Electric generator.

WATTS, CAL.—The Pacific Light & Power Company has been granted a fifty-year franchise to supply electricity for lamps and motors in Watts.

WOODLAND, CAL.—The Sacramento-Woodland Electric Railway Company has awarded a contract for the construction of its proposed railway from Woodland to Sacramento to the Dozier Contracting & Engineering Company.

BOULDER, COL.—The City Council has granted the Boulder Electric Light & Power Company a franchise to extend its street-railway system into the northern section of the town. The extension will require about 2 miles of track and will cost about $15,000.

TELLURIDE, COL.—The Telluride Electric Light & Power Company has submitted a proposition to light the streets of the city under a five-year contract as follows: For 2000-cp lamps at $3 each per month; 50-cp incandescent lamps at $1.25 per lamp per month, with all-night service, and 16-cp incandescent lamps for lighting the city buildings at 75 cents each per month. The company also offers to furnish 16-cp lamps at 75 cents per lamp per month for residences, with a minimum charge of $1 per month, and to supply electricity for lamps for residences at 12½

cents per kw-hour, with a discount of 2½ cents per kw-hour for prompt payment, provided that the minimum charge will be $1.50 per month. The meter deposit has been reduced to $10. For commercial purposes the company will supply 16-cp lamps, burning until 10 o'clock, at 60 cents per lamp per month, and with all-night service, $1.50 each per month, with a minimum charge of $1 per month; standard arc lamps for private use, burning until 10 o'clock, at $5 each per month; with all-night service, $9 each per month. The company was enabled to make reductions in its rates because of concessions made by the Telluride Power Company, which furnishes energy for operating the local system.

MANSFIELD, CONN.—It is reported that plans are being considered for the erection of several new buildings for the Connecticut colony of epileptics at Mansfield, including power and heating plant, water supply, etc.

MANCHESTER, CONN.—The Manchester Light & Power Company and the South Manchester Light, Power & Tramway Company have been consolidated and will be operated under the name of the latter company. The company will supply electricity for lamps and motors in the villages of Manchester and South Manchester and to operate the electric railways running through the town. The company is capitalized at $40,000.

WALLINGFORD, CONN.—It is reported that new bids will be called for during the next six weeks for additional equipment for the municipal electric-light plant, consisting of a 500-kw turbine and other electrical equipment, to cost approximately $30,000.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Commissioners of District of Columbia, Washington, D. C., until Nov. 9 for furnishing and installing electric wiring, switches, wall plugs, lamps, reflectors, etc., in the Eastern High School. Plans and specifications and form of proposal may be obtained from the purchasing officer of the District of Columbia.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 14 for furnishing at the navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 4038—Miscellaneous brass and copper pipe, sheet brass, rolled naval brass and copper rod; Schedule 4051—Transformers. Boston, Mass., and Brooklyn, N. Y., Schedule 4038—Miscellaneous sheet copper. Norfolk, Va., Schedule 4051—One generator set. Applications for proposals should designate schedules desired by number.

BROOKSVILLE, FLA.—At an election to be held Nov. 24 the proposition to grant a franchise to Mr. Fuller, of Umatilla, to install an electric-light plant and water-works system will be submitted to a vote.

WINTER HAVEN, FLA.—Preparations are being made to install an electric-light system in Winter Haven. Boyd Brothers are interested in the project.

ATLANTA, GA.—The Georgia Railway & Power Company, of Atlanta, Ga., has purchased the property of the Savannah River Power Company, of Anderson, S. C., for $1,550,000. In order to acquire other properties the Georgia Railway & Power Company has applied to the Georgia Railway Commission for permission to issue $30,000,000 in bonds and $37,000,000 in capital stock. The Georgia company has secured options on the system of the Georgia Railway & Electric Company, of Atlanta, and the water-power properties at Tallulah Falls, Gainesville, Cartersville, two other properties at Newman, Ga., and one at Cherokee Falls. It is reported that the plans of the new company include the extension of the interurban electric railway from Anderson to Atlanta. Charles McGee, of Toronto, Can., is president of the Georgia Railway & Power Company.

ROYSTON, GA.—It is reported that plans are being considered by James J. Roberts to establish an electric-light and power plant to supply electricity for lamps and motors in two or more towns.

SUMMERVILLE, GA.—The Village Council has authorized the Mayor to enter into a contract with the Augusta-Aiken Railway & Electric Company for street lighting. The contract calls for about 200 tungsten lamps of 60 cp and eight or ten arc lamps. The town will be rewired throughout.

WASHINGTON, GA.—A site has been purchased by the city near the Georgia railroad tracks at the depot on which it will erect a new municipal electric-light plant at a cost of about $25,000. Contracts for construction of the plant will be soon awarded. When the new plant is completed a twenty-four-hour service will be established.

BATAVIA, ILL.—Plans are being considered by the Aurora, Elgin & Chicago Railroad Company for the installation of a 5000-kw turbine engine, increasing the output of the plant to 8500 kw. An addition will be built to the power house.

BATAVIA, ILL.—The City Council has authorized the light committee to make an investigation of the equipment of the municipal electric-light plant with a view of making improvements to the plant. It is proposed to replace the engine now in use with a steam turbine.

BEARDSTOWN, ILL.—The electric light committee of the City Council has adopted a resolution recommending the installation of a municipal electric-light plant in Beardstown.

CHAMPAIGN, ILL.—The City Council has authorized the city engineer to prepare plans and specifications for a street-lighting system to consist of 800 tungsten lamps to be placed on concrete standards with lead-covered cables placed in underground conduits.

EAST ST. LOUIS, ILL.—It is understood that arrangements have been made whereby the East St. Louis & Suburban Railway Company will supply the East St. Louis, Columbia & Waterloo Railway Company with energy to operate its railway until the company builds its own power house. The East St. Louis, Columbia & Waterloo Railway Company expects to have cars running between Dupo and East St. Louis by Jan. 1.

FARMINGTON, ILL.—The Farmington Light & Power Company is contemplating erecting a transmission line southwest of the city to supply electricity to the farmers in that section.

MATTOON, ILL.—Plans have been submitted to the City Council by City Engineer James for the installation of a flashlight alarm and telephone system for the police.

MOKENA, ILL.—The Village Board, it is reported, will install a municipal electric-light plant if satisfactory arrangements cannot be made with the North Shore Electric Company for the erection of a transmission line to this village.

OKEGON, ILL.—Preparations are being made by the Oregon Power Company for extensive improvements to its plant next year. The proposed improvements will be made during the winter and will double the present output of the plant. The company now supplies electrical service in Polo, Mount Morris, Oregon, Franklin Grove, Lee Center, Amboy, Sublette, Compton, Shaw Station and Ashton, and is contemplating extending its transmission lines to other towns in this section of the State.

PETERSBURG, ILL.—Abbott Brothers, owners of the local electric-light plant in Petersburg, have taken over the electric-light system in Tallula, where the plant was recently destroyed by fire, and will erect a transmission line from their plant in this city to supply electricity in that town.

PROPHETSTOWN, ILL.—Plans are being considered for the installation of a 130-hp engine in the local electric-light plant next spring.

SHELDON, ILL.—The Sheldon Electric Light & Power Company, it is reported, is contemplating the installation of an ice plant. Robert Ross has been elected president of the company.

STREATOR, ILL.—The City Council is considering the question of installing an ornamental street-lighting system in Streator. The Illinois Valley Gas & Electric Company has submitted a proposition offering to install 220 or 230 arc lamps in the business district and 200 lamps in the residence section, one-half to burn all night and the remainder on a moonlight schedule.

SULLIVAN, ILL.—The Sullivan Electric Company is contemplating extending its transmission line to Arthur. The company is enlarging its power house and will install additional machinery.

TAYLORSVILLE, ILL.—The City Council has notified the Taylorsville Gas & Electric Company that it must remove its poles from the square and replace all uninsulated wires with stranded wire within the limits of the city. Unless the company complies with the ordinance its franchise will be forfeited. The company is given thirty days to comply with the order.

FT. WAYNE, IND.—The Kehoe Light & Power Company, recently incorporated with a capital stock of $100,000, proposes to furnish electricity for lamps and motors to small towns along the lines of the interurban railways within a radius of 50 miles of Ft. Wayne. At present the company will confine itself to the towns along the lines of the Ft. Wayne & Northern Indiana Traction Company. A contract has already been signed whereby the company will supply electricity to light the town of Ossian. Energy for operating the system will be secured from the traction company. The officers are: C. M. Niezer, president; T. J. Kehoe, vice-president, and M. J. Kehoe, secretary and treasurer.

FRANCISVILLE, IND.—The Central Indiana Water, Light, Heat & Power Company, recently incorporated, it is reported, will soon ask for proposals for construction of water, light, heat and power plants in a number of nearby towns and cities. E. A. Rossiter is president of the company.

GOSHEN, IND.—The Goshen Home Telephone Company is planning to erect a new copper telephone line between Goshen and Bristol, and to make other improvements to its system.

MARTINSVILLE, IND.—The street-lighting committee has rejected all bids submitted for the proposed new plant and is now investigating the cost of purchasing the material direct. The committee is also considering the question of installing an ornamental street-lighting system.

SHELBYVILLE, IND.—The plant and holdings of the Shelby County Water, Gas & Electric Company have been taken over by the Indiana Service Company. H. L. Olds, of Indianapolis, Ind., is president of the company.

SOUTH BEND, IND.—The Board of School Trustees is considering the question of installing an electric-generating plant in the new high school, now in course of construction. George Knoblock is president of the board.

WASHINGTON, IND.—The promoters of the Vincennes, Washington & Eastern Traction Company have submitted a proposition to the city offering to take over the municipal electric plant and operate it in connection with the interurban system.

BRIGHTON, IA.—The Brighton mill dam and water rights, including a site for the erection of a hydroelectric plant, have been purchased by L. Whitney, of Mount Pleasant, and L. J. Highland, of Burlington, for

$8,000. Work will soon begin on construction of the plant, which when completed will supply electricity to Brighton and towns in this vicinity.

CHARLES CITY, IA.—The citizens have voted to grant C. Walker a franchise to operate an electric-light plant in Charles City.

CLARINDA, IA.—The Lee Electric Light Company has entered into a contract with the Bedford Light, Heat & Power Company to supply electricity to operate the electric system in Bedford, 23 miles distant. The Bedford company will close down its generating plant as soon as energy is received from the Lee company. Preparations are being made by the Lee Electric Light Company to extend its transmission line from New Market, the present terminus, to Bedford, a distance of 15 miles. Electrical service will also be supplied to residents along the route of the proposed line.

CLARION, IA.—After being without electrical service for seventy-three days, due to the burning of the electric-light plant, the service has been resumed. An entire new plant is being built. Electroliers are being erected for the new street-lighting system.

COON RAPIDS, IA.—The City Council it is reported, has approved plans for the installation of electroliers on Main Street.

DUNLAP, IA.—At an election held recently the voters approved the granting of a franchise to L. R. Betts, of Council Bluffs, to construct and operate an electric-light plant in Dunlap. It is understood that work will begin on construction of the plant at once.

FOREST CITY, IA.—If granted a franchise, the Forest City Electric Light & Power Company will make extensive improvements to its system, involving an expenditure of about $10,000.

GALVA, IA.—The proposition to issue bonds to the amount of $8,500 for the construction of an electric-light plant in Galva will be submitted to a vote.

HARLAN, IA.—Owing to the blowing out of a cylinder head on the large engine in the municipal electric-light plant the service is badly crippled. It will take about a month to make the necessary repairs. George W. Cox is superintendent.

JEWELL, IA.—Plans are being considered for the installation of an ornamental street-lighting system. It is proposed to erect ornamental lamp standards with cluster lamps.

OSCALOOSA, IA.—The Des Moines River Power Company has purchased the property of the Oskaloosa Traction & Light Company, which included the electric-light plant, heating plant, the local street-railway system, the Oskaloosa and Buxton electric railway, the municipal lighting franchise and the city heating franchise. The price paid for the plant is understood to be about $200,000. The Des Moines company is contemplating the development of several power sites along the Des Moines River and is planning to build a dam about 7 miles from Oskaloosa on the Des Moines River to develop about 10,000 hp. The new company will carry out the contracts of the old company, including the erection of a transmission line to New Sharon, 12 miles north of the city. A. C. Miller, of Des Moines, Ia., is interested in the new company.

POCAHONTAS, IA.—The contract for construction of a municipal electric-light plant for the city of Pocahontas, bids for which were opened Oct. 27, has been awarded to the Dwyer Field Company, of St. Paul, Minn., at $11,800. George Schnieders is clerk.

ROLAND, IA.—The installation of an electrolier system of street lighting is reported to be under consideration.

STORY CITY, IA.—The Commercial Club is considering the question of installing an electrolier system of street lighting in Story City.

VAN HORNE, IA.—Bonds to the amount of $10,000 have been voted for the installation of a municipal electric-light plant in Van Horne. The town has been without electrical service since the plant of the Van Horne Electric Light & Power Company was destroyed by fire early last spring.

OSBORNE, KAN.—The City Council, it is reported, will soon call an election to vote on the proposition to issue bonds to the amount of $25,000 for the construction of a municipal electric-light plant. Plans and specifications for the proposed plant have been prepared by Rollins & Westover, of Kansas City, Mo.

WATERVILLE, KAN.—Plans are being considered for the construction of a municipal electric-light plant in Waterville, Kan., for which bonds to the amount of $30,000 have been voted. Mr. Black, of the J. S. Worley Engineering Company, of Kansas City, Mo., is engineer in charge.

CAMPBELLSVILLE, KY.—Owing to the City Council and the Campbellsville Electric Light Company being unable to come to an agreement in regard to the rates for street lighting, the company has discontinued the service. The company has been supplying arc lamps at $50 each per year. The company has increased its rates for the service, claiming that it was furnishing the service at a loss under the old contract.

CUMBERLAND FALLS, KY.—It is reported that H. M. Byllesby & Company, of Chicago, Ill., are making surveys at Cumberland Falls, on the Cumberland River, near Williamsburg, with a view of developing the water power to be utilized to generate electricity for transmission to Lexington, Ky., Knoxville, Tenn., and other smaller cities.

MILLERSBURG, KY.—Preparations are being made for the installation of a municipal electric-light plant in Millersburg. It is understood that contracts for machinery have been awarded.

SHREVEPORT, LA.—At a referendum election held Oct. 20, called at the demand of the Municipal Ownership League, the voters approved the contract entered into between the City Commissioners and the Shreveport Gas, Electric Light & Power Company for lighting the streets of the city for a period of six years, under the terms of which the company is to supply arc lamps at $62.50 each per year, which is $12.50 per lamp less than the city is paying under the present contract, and means a saving of about $20,000 during the next six years. In addition to the reduction in price for the service the company agrees to install over sixty lamps at locations donated by the Council and to supply electricity to light the city hall free of charge. The voters defeated the proposition to issue $310,000 in bonds to establish a municipal plant at a special election held Oct. 17.

PORTLAND, MAINE.—The New Hampshire Water & Electric Power Company has filed an amendment to its charter increasing its capital stock from $100,000 to $200,000.

PORTLAND, MAINE.—Plans are being considered for the installation of new street lamps on Congress and Middle Streets. It is proposed to erect tungsten cluster lamps.

BALTIMORE, MD.—The Board of Estimate is considering the question of installing ornamental electric lamps on Charles Street Avenue, the St. Paul Lane Boulevard and Merryman Lane Boulevard. The Peabody Heights Improvement Association has petitioned for electric lamps in that district. The cost of installing the lamps is estimated at $13,076, and the maintenance for a period of six months dating from July, 1912, will amount to $1,154.

SALISBURY, MD.—The Salisbury Light, Heat & Power Company is planning to establish a twenty-four-hour service in the near future. The meter system will be installed and the minimum charge will be reduced from $1.50 to $1 per month.

LEE, MASS.—The Berkshire Street Railway Company has purchased of the Lee Lime Company the mill building, water privilege and two tenement houses, known as the Bostwick shoddy mill property in Lee. It is stated that the consideration was about $10,000.

BAY CITY, MICH.—Extensive improvements are being made to the plant of the Kolb Brewing Company, including the installation of a power plant which will provide electricity to operate its bottling works.

DETROIT, MICH.—A special meeting of the stockholders of the Detroit Edison Company will be held Nov. 15 to vote on the proposition to increase the capital stock of the company from $9,000,000 to $15,000,000. It is proposed to issue $1,500,000 of the new stock in the near future, which will be offered to the stockholders at par.

MUSKEGON, MICH.—Owing to inability to secure satisfactory rates for lighting the city from the Muskegon Traction & Lighting Company or the Grand Rapids-Muskegon Power Company, the members of the City Council, it is reported, are working to secure the co-operation of other smaller cities in Muskegon, Oceana and Newaygo Counties in a large municipal light and power plant project. It is proposed that the cities of Muskegon, Whitehall and Montague, in Muskegon County; Fremont, in Newaygo County, and Hart and Shelby, in Oceana County, shall purchase jointly the rights of the Wheeler Power Company to a power site on White River and erect a hydroelectric plant to supply electricity to the different cities.

KOMEO, MICH.—The Detroit Edison Company, of Detroit, Mich., it is reported, is negotiating for the purchase of the local municipal electric-light plant. The company has made an inventory of the plant with a view of making a bid for it should the plant be offered for sale. The plant was established twelve years ago and cost about $35,000. There is a demand for a twenty-four-hour service, which will require an expenditure of $1,600 to equip the plant for the extra service.

AITKIN, MINN.—M. D. Stoner, president of the Cuyuna Light & Power Company, of Deerwood, Minn., has withdrawn his offer to lease the Aitkin power plant and to furnish a continuous service for lamps and motors and to operate the pumping plant of the village, and also to install an electric fire-alarm system, owing to adverse report submitted by the special committee appointed to investigate the proposition. Mr. Stoner supplies electricity for lamps and motors in Deerwood, Cuyuna, Ironton, Crosby and other parts of the Cuyuna iron range.

BALATON, MINN.—The installation of an electric-light plant in Balaton is reported to be under consideration. Local business men are interested in the project.

MAYNARD, MINN.—The question of issuing bonds to the amount of $5,000 for the installation of a municipal electric-light plant in Maynard is under consideration.

MINNEAPOLIS, MINN.—Preliminary work has been started on the power dam of the Great Northern Development Company at Coon Creek, on the Mississippi River, 10 miles from Minneapolis. Contracts have been awarded for grading embankment. It is expected to have the dam completed within one year. It is estimated that 15,000 hp can be developed at Coon Creek.

OLIVIA, MINN.—The installation of a new generator in the municipal electric-light plant is reported to be under consideration.

PIERZ, MINN.—It is reported that the private telephone line, owned by P. W. Blake, has been purchased by John Stroming, of Swanville, who, it is said, will extend the line 15 miles.

VIRGINIA, MINN.—The proposition to acquire the electric plant of the Virginia Electric Light, Power & Water Company will be submitted to a vote at an election to be held Nov. 21.

ST. LOUIS, MO.—The West End Light & Power Company has filed with the Public Service Commission a schedule of its rates, placing the maximum charge at 9½ cents per kw-hour, the rate fixed by the commission. A minimum charge of 50 cents per month was also named.

BUTTE, MONT.—The County Commissioners have awarded the contract for electric fixtures for the new court house to the Butte Electric & Supply Company for $10,000.

MILES CITY, MONT.—Plans are being considered by the Mountain States Telephone Company for the erection of about 10 miles of rural telephone lines.

TERRY, MONT.—At an election held Oct. 9 the citizens voted to grant a franchise to E. H. Phillips to construct and operate an electric-light plant in Terry.

BEAVER CITY, NEB.—The installation of an electric-light plant in Beaver City is under consideration. It is proposed to organize a stock company to construct and operate the system.

KEARNEY, NEB.—The City Council has voted to submit the proposition to appropriate $50,000 for the construction of a municipal electric-light plant to the voters.

OVERTON, NEB.—W. H. Hill, who was recently granted a franchise to install an electric-light plant by the Village Board, is planning to construct a plant to cost from $6,000 to $7,000. C. W. Hill, of Overton, is engineer in charge.

FALLON, NEV.—Sealed bids will be received at the office of the United States Reclamation Service, Fallon, Nev., until Dec. 6 for the lease from the United States of electric energy generated at the Lahontan dam of the Truckee-Carson project. For further information address the United States Reclamation Service at Washington, D. C.; Fallon, Nev., or Los Angeles, Cal. F. H. Newell is director.

ASHUELOT, N. H.—The Keene Gas & Electric Company, of Keene, N. H., has applied to the Public Service Commission for permission to sell its lines and system in Ashuelot to the Ashuelot company. The latter company has petitioned the commission for authority to issue sufficient additional capital stock to take over the business.

MANCHESTER, N. H.—The Board of Mayor and Aldermen has voted to authorize the Manchester Street Railway Company to replace the wooden poles supporting the trolley wires with iron poles throughout the city.

BINGHAMTON, N. Y.—The contract for the construction of an electric conduit system and installation of boulevard lamp-posts in the city of Binghamton, bids for which were opened Oct. 25, has been awarded to G. M. Gest, of New York, N. Y., the cost not to exceed $22,200.

BROCKPORT, N. Y.—The Brockport Gas & Electric Light Company has applied to the Public Service Commission, Second District, for permission to execute a mortgage for $150,000 and to issue presently $80,000 in bonds.

DUNDEE, N. Y.—The Board of Village Trustees has decided not to accept the proposition submitted by E. L. Bailey, proprietor of the local electric-light plant, whereby the village was to take over the plant.

NEW BRIGHTON, N. Y.—The Board of Estimate and Apportionment has adopted a resolution providing for an issue of corporate stock of the city of New York to an amount not exceeding $100,000, the proceeds to be used to purchase and install necessary engines, boilers and appurtenances and electrical equipment at the new Grant City pumping station, borough of Richmond, in connection with improving the water supply system of the borough.

NEW YORK, N. Y.—The Public Service Commission, Second District, has granted the Bronx Gas & Electric Company permission to issue $80,000 in bonds, the proceeds to be used for extensions and improvements to its system.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until Nov. 6 for furnishing and installing new lighting equipment and rearranging old equipment, as specified, at the Morgue buildings on the dock at the foot of East Twenty-sixth Street. Blank forms and further information may be obtained at the office of the supervising engineer of the department, foot of East Twenty-sixth Street, where plans and specifications may be seen. Michael J. Drummond is commissioner.

ROCHESTER, N. Y.—The Livingston-Niagara Power Company, recently incorporated, has perfected organization, and the following officers have been elected: Merton E. Lewis, of Rochester, president; Q. W. Hershey, of Avon, N. Y., and C. J. Brown, of Rochester, vice-presidents; Harry G. Strong, of Rochester, secretary, and H. C. Brewster, treasurer. The company has been granted permission by the Public Service Commission to issue capital stock to the amount of $85,000. An open mortgage of $600,000 has been recommended by the commission, thereby permitting issuing of bonds to that amount as the needs of the company may require, to be approved by the commission. Under the present authorization the company is permitted to make an immediate issue of $268,421, to be sold at not less than 95. The company has taken over several important power companies in Livingston County. Following the completion of the power station at Golah, where energy from Niagara is stepped down for distribution, the company has been rushing work on the erection of its distributing lines. Electrical service is already supplied by the company in Avon and Livonia over one of its new lines. Energy is also supplied to the Lima-Honeoye Falls electric railway and also to the State Agriculture and Industrial School at Industry. Plans are being made to begin work on the erection of the transmission line extending from the power station at Golah to Scottsville, and possibly to Mumford. The line will eventually be extended to Caledonia. It is expected to have the line completed to Scottsville by the first of the year.

DEVIL'S LAKE, N. D.—The Stetler Investment Company, of Devil's Lake, has purchased the railway of the Devil's Lake & Chautauqua Railway Company, which reaches summer resorts on the shores of Devil's Lake. It is announced that the railway will be equipped for electrical operation immediately.

SHARON, N. D.—The Sharon Electric Light & Power Company is reported to have awarded a contract for the installation of a new lighting system in Sharon to the Battery & Globe Electric Company, of Milwaukee, Wis.

McVILLE, N. D.—The installation of an electric-light system in McVille is reported to be under consideration.

COLUMBUS, OHIO.—The contract for furnishing 320 arc lamps to be used in extending the municipal lighting system over the recently annexed territory has been awarded to the General Electric Company, of Schenectady, N. Y. The lamps and four rectifer equipments for the lighting plant will cost $11,190.

HAMILTON, OHIO.—The Hamilton Gas & Electric Company is reported to have applied to the federal court in Cincinnati, Ohio, for a receiver. The company states that, owing to the competition of the municipal gas plant, recently completed, it is no longer able to pay dividends. The liabilities of the company are placed at $1,000,000 and the assets at $800,000. J. C. Thomas, of Cincinnati, Ohio, is president of the company.

NILES, OHIO.—The installation of a new street-lighting system in Niles is under consideration.

BUTLER, OKLA.—Messrs. Kise & Mason have purchased a site in Butler on which they propose to erect an electric-light plant. Work will begin at once on the proposed plant.

GUTHRIE, OKLA.—The City Council is reported to be contemplating the purchase of the franchise of the Guthrie Light & Power Company.

BANDON, ORE.—The Smith-Powers Logging Company is reported to be contemplating establishing a large electric plant, to cost from $400,000 to $500,000, and extend high-tension lines to its various logging camps to supply electricity for logging operations. The company is now making tests of the electric donkey engine.

GATES, ORE.—Plans are being considered by the Silver King Mining Company, which operates in the Elkhorn district, for the erection of an electric smelting plant.

RIDDLE, ORE.—The Riddle Development League is contemplating the installation of an electric-light plant to supply electricity to the residents of the Umpqua Valley.

GREENVILLE, PA.—H. Borland, of Pittsburgh, acting for Eastern capitalists, has purchased the plant of the Greenville Electric Light, Heat & Power Company. The consideration is said to be $100,000. It is understood that the new owners will rebuild the plant.

JOHNSTOWN, PA.—The Penn Central Light & Power Company is reported to be negotiating for the purchase of electric-light properties in Cambria County on the route of its system from Huntingdon County into this county. The company has taken an option on the electric plant in Lily, owned by Julius F. Klemstine, and is also negotiating with the Citizens' Light, Heat & Power Company, of Portage, for its property. The Citizens' company supplies electricity in Portage, Jamestown and Cassandra, and is also planning to extend its transmission lines into Wilmore.

PITTSBURGH, PA.—Negotiations are under way between John W. Garland, of Pittsburgh, Pa., chairman of the reorganization committee of the National Telephone bondholders, and a syndicate of capitalists by which the latter will acquire the independent telephone companies operating in New Jersey, Pennsylvania, West Virginia, Ohio, Indiana and part of Illinois. The deal will mean the payment of $10,000,000 in cash and the issuance of $22,000,000 in bonds.

WARREN, PA.—The City Council has passed an ordinance requiring all wires, except those of the Warren Electrical Light Company, placed underground in the business section of the city. The Bell Telephone Company of Pennsylvania was granted a franchise to lay its conduits throughout the borough. The ordinance requires that the Bell company rent space in its conduit to the American Bell Telephone Company, the Postal Telegraph and the Western Union Telegraph companies. Improvements are contemplated by the Bell company in Warren, which will involve an expenditure of about $75,000.

SIOUX FALLS, S. D.—A petition has been presented to the City Commission asking for the installation of ornamental lamps on Main Avenue from Fifth to Twelfth Street.

WOONSOCKET, S. D.—The Shuler Electric Company has applied to the City Council for a franchise to install and operate an electric-light plant in Woonsocket.

CHATTANOOGA, TENN.—It is announced that the Eastern Tennessee Power Company, which is erecting a large power plant on the Ocee River, near Parksville, Tenn., will be ready to supply electricity in Chattanooga, Knoxville and Rome, Tenn., by Jan. 1, 1912. Contracts are now being made for service to begin at that date.

COOKEVILLE, TENN.—The proposition to issue bonds to the amount of $30,000 for improvements and extensions to the municipal electric-light plant and water-works system will be submitted to a vote at an election to be held Nov. 25.

PULASKI, TENN.—Plans are being considered for rebuilding the municipal electric-light plant. It is understood that bids will soon be called for construction of a new plant.

BROWNSVILLE, TEX.—Bonds to the amount of $50,000 have been authorized, the proceeds to be used for improvements to the municipal electric-light plant and water-works system.

CALVERT, TEX.—The City Council has granted the Calvert Water, Ice & Electric Light Company a renewal of its franchise for a period of twenty-five years.

CARLSBAD, TEX.—Bids will be received by the Anti-Tuberculosis Commission of Texas, Austin, Tex., until Nov. 14 for the erection of a tuberculosis sanatorium at Carlsbad, to include administration, subsistence, power and equipment buildings, infirmary, barns and lean-tos. Plans and specifications may be obtained at the office of the commission, Austin; Concho Land Company, San Angelo, Tex., and Henry T. Phelps, architect, San Antonio, Tex. Ralph Steiner, M.D., is chairman of the commission.

GIDDINGS, TEX.—The Giddings Creamery Company has changed its name to the Giddings Creamery-Ice Manufacturing Company. The company is capitalized at $20,000 and contemplates operating an electric light plant in addition to its ice and cold-storage business.

PECOS, TEX.—Judge James F. Ross, of Pecos, Tex., who represents Cobe, McKenna & Company, agents of the Balmorhea and Toyah irrigation systems, has submitted a proposition to build an irrigation dam in the Toyah Valley at a cost of about $200,000. The proposed system is to be built and operated on the plan of the Carlsbad dam built by the government at Carlsbad, N. M., and the Elephant Butte dam project now under construction above El Paso in New Mexico.

YOAKUM, TEX.—The Yoakum Improvement Company is planning to install a 500-hp engine and a 150-kw, 60-cycle generator in its plant. J. W. Greer is secretary and manager.

RICHMOND, VA.—The Washington & Old Dominion Railroad Company has leased the Bluemont branch of the Southern Railway, extending from Alexandria to Bluemont, a distance of 39 miles, for a term of fifty years from July 1, 1912. It is understood that the road will be equipped for electrical operation as soon as possible.

ROANOKE, VA.—The Roanoke Railway & Electric Company is reported to have entered into a contract with the Appalachian Power Company to supply electrical energy generated at the hydroelectric plant on New River in Roanoke. Electricity will be transmitted at 80,000 volts to the substation of the Roanoke Railway & Electric Company on Walnut Street.

CASTLE ROCK, WASH.—The City Council has granted H. B. Davis, J. W. Seldon and the Tacoma Investment Company a fifty-year franchise to construct and operate an electric-light plant in Castle Rock. The company was also given a contract to light the streets of the city for a period of five years.

DAYTON, WASH.—The Pacific Power & Light Company, which recently acquired the property of the Dayton Electric Light Company, is planning to make extensions and improvements to the local system. The Pacific company has extended its transmission line into the city.

SEATTLE, WASH.—The City Council has passed ordinances providing for enlarging the municipal lighting plant at a cost of $1,000,000 and for improvements to the city water-works system to cost $500,000.

SEATTLE, WASH.—R. H. Thomson, city engineer, has submitted a report to the City Utilities Committee in which he recommends two power projects to be owned by the municipality. The report submitted stated that 25,000 hp could be developed by the Lake Cushman project at an approximate cost of $2,325,000 and that 40,000 hp could be obtained in connection with the White River project, the cost of which is estimated at about $3,560,000.

SNOHOMISH, WASH.—The City Council has authorized the Mayor and the city clerk to enter into a new contract for street lighting with the Everett Gas Company for a period of ten years. This contract provides for not less than thirty-five magnetite arc lamps at $72 each per year.

SPOKANE, WASH.—Plans have been filed with the City Commissioners for the installation of an ornamental lighting system on Second Avenue between Division and Walnut Streets. The plans call for the erection of ninety-four electroliers, each carrying five lamps. The total cost of the system is estimated at $56,400, of which the property owners will be asked to pay $45,400. The cost of the electroliers at $123 each aggregates $11,562, and the maintenance at $48 each per year for ten years will be $45,120. The actual cost to the city will be the cost of lighting the street.

WALLA WALLA, WASH.—The Pacific Power & Light Company has applied for franchises for extensions to its transmission lines in Walla Walla County. The company proposes to install systems in Dixie, Two Rivers, Burbank, Attalia and other small towns in this section.

WALLA WALLA, WASH.—Plans are being considered by the Pacific Telephone & Telegraph Company for extensive improvements and extensions to its toll lines, involving an expenditure of $80,000, including the erection of a toll line between Walla Walla and Touchet, to cost $1,000; a line from this city to Colfax, $17,200; a line between Prosser and Wallula, $14,000; a line between North Yakima and Prosser, $15,000, and a line between Arlington and state line points, $30,000.

WHEELING, W. VA.—The County Commissioners have entered into a contract with the Wheeling Electrical Company to supply electricity to light the county building.

DE PERE, WIS.—Orders have been placed by the De Pere Electric Light & Power Company for a new switchboard and regulating machinery. The new equipment will be utilized in connection with the current from the High Falls as well as power generated at the local plant. The cost of the improvements is estimated at about $3,000.

MANITOWOC, WIS.—The City Council is reported to have voted to issue bonds for improvements to the water and light plant.

MILTON, WIS.—The Milton Water, Light & Power Company, recently organized, has been granted a franchise to construct and operate an electric-light plant in Milton. Work has already begun on the plant, and orders have been placed for equipment for the electric plant. It is understood that the company is planning to build a water-works system in the spring. Dr. J. H. Burdick and Dr. G. E. Crossley are interested in the company.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company, it is reported, will issue $2,000,000 additional refunding and extension mortgage bonds.

VERMILION, ALTA., CAN.—The contract for the construction of a new electric power house in Vermilion is reported to have been awarded to Ferrell & Walker.

WINNIPEG, MAN., CAN.—The plant and holdings of the Winnipeg Electric Company, which supplies electricity, gas and street-railway service in Winnipeg and vicinity, are reported to have been purchased by the E. R. Reese Engineering Company, an American concern. The new owners, it is said, will build rural lines throughout the province.

BEACHVILLE, ONT., CAN.—At an election held recently the ratepayers voted to appropriate funds for the installation of a distributing system for Niagara power to be supplied by the Hydroelectric Power Commission. The village of Boden also voted in favor of an appropriation to install a distributing system to utilize energy supplied by the Hydroelectric Power Commission.

BERLIN, ONT., CAN.—The City Council has adopted a resolution providing for the installation of a new street-lighting system. The present plan calls for the erection of 1500 lamps of 100 cp to be placed throughout the entire town before the first of the year.

HAMILTON, ONT., CAN.—The controllers have decided to place orders at once for duplicating the present electric pumping equipment at the Beach water-works station, providing the Council grants its approval. It has also been decided to notify the Hydroelectric Commission that an additional 1000 hp will be required by Nov. 1, 1912, in addition to the 1000 hp now taken by the city. By that time the city expects to supply electricity for lighting all the municipal buildings, Gore Park, and probably some of the schools and the government buildings in the city.

HAMILTON, ONT., CAN.—Proposals will be asked for during the next two months by the Hydroelectric Department of the city of Hamilton for material required in the construction of a distributing plant for energy supplied by the Hydroelectric Power Commission throughout the city of Hamilton as follows: (a) Substation buildings, heating, lighting, plumbing, etc., for same; (b) station equipment, including transformers, switches, switchboards, lightning arresters, instruments, oil tanks, etc.; (c) wooden poles, cross-arms, pins, side blocks, braces, insulators, machine bolts, pole steps, guy wire, etc.; (d) reinforced poles, condulets, conduits, steel reinforcing, cross-arms and castings; (e) underground conduit system construction, including cable racks, manholes and manhole castings, structural steel, pillars and castings, (f) conduit ducts, tile, fibre or other system for underground distribution; (g) weatherproof and rubber-covered copper and aluminum solid and standard wire, lead-incased cables and installation of same, distribution boxes, pot-head and connectors; (h) line transformers, meters, cut-outs and devices, lamps, wiring supplies or other appliances, devices, apparatus or material to be used in connection with construction and equipment of above. Companies, firms or individuals desiring to submit bids on any of the above equipment or apparatus must file application for specifications with E. I. Sifton, consulting engineer, City Hall, Hamilton, Ont., Can., stating specifically the portions and sections they wish to bid on. For sections A, B and E a deposit of $10 will be required, which will be refunded on return of same. George H. Lees is Mayor.

MIMICO, ONT., CAN.—The municipality of Mimico has entered into a contract with the Hydroelectric Power Commission for 50 hp at $31.50 per hp per year for a period of fifty years.

ST. MARY'S, ONT., CAN.—At an election held recently the by-law appropriating $15,000 to secure energy from the Hydroelectric Power Commission was carried.

THREE RIVERS, QUE., CAN.—The citizens have voted to construct a street-railway system to be owned and operated by the municipality, to cost approximately $800,000.

SCOTT, SASK., CAN.—Contracts have been awarded by the town of Scott for construction and equipment of a combined electric-light and water plant, amounting to $28,310.

New Industrial Companies.

THE CAPITAL GAS ENGINE COMPANY, of Sacramento, Cal., has been organized with a capital stock of $100,000 to manufacture a gas engine which will embody the inventions of James Shaw, one of the owners of the Bell machine shop. The new company has taken over the Bell plant and will enlarge same. The incorporators are: James Shaw, F. F. Thomson, C. H. Hardy, A. F. Harrison and W. A. Mackinder.

THE EASTMAN MOTOR TRUCK COMPANY OF AMERICA, of Wilmington, Del., has filed articles of incorporation with a capital stock of $25,000. The incorporators are: J. H. Shields, of Minneapolis, Minn.; C. E. Semmes, of Washington, D. C.; L. J. Eastman, B. R. Kenworthy, Philadelphia, Pa., and H. G. Eastburn, of Wilmington, Del.

THE ECONOMIC BLOWER COMPANY, of New Jersey, has filed articles of incorporation with a capital stock of $100,000 to manufacture machinery, engines and mechanical devices. The incorporators are: A. C. Reeves and T. F. Farrell, of Jersey City, N. J., and W. Grupe, of Hoboken, N. J.

THE ELECTRIC AD-LITE COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing electrical and mechanical devices. The incorporators are: Joseph G. Kanter, Benjamin F. Kanter and Frank V. Daniles, all of 32 Union Square, New York, N. Y.

THE EVANS FITTING COMPANY, of Camden, N. J., has been granted a charter with a capital stock of $50,000. The company proposes to manufacture steel fittings for hydraulic and other piping. The incorporators are: F. R. Hansell, J. A. MacPeak and I. C. Clow, of Camden, N. J.

THE GALLAGHER-TOMPKINS COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $175,000 for the purpose of manufacturing engines, machinery, etc. The incorporators are: F. B. Tomkins, R. W. Gallagher and G. D. Zahm, of New York, N. Y.

THE GENERAL ELECTRIC OZONE COMPANY OF AMERICA has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $200,000. The incorporators are: N. P. Coffin, W. J. Maloney and H. E. Latter, of Wilmington, Del.

THE GENERAL GLASS MANUUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to manufacture glass signs, lamps, metal goods, etc. The incorporators are: R. S. Fox, H. S. Hanson and James S. Miller.

THE HALLDOW MANUFACTURING COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $10,000 to manufacture electrical appliances. The incorporators are: Charles M. Mudge, H. U. Mudge and L. C. Seward, of 1007 La Salle Street, Chicago, Ill.

THE HATCH OIL ENGINE COMPANY, of New York, N. Y., has been incorporated by C. W. Hatch, W. P. Hatch, Jr., and A. Anderson, of Brooklyn, N. Y. The company is capitalized at $100,000 and proposes to manufacture machinery.

THE HOOSIER SALES COMPANY, of Jamestown, N. Y., has filed articles of incorporation with a capital stock of $150,000 for the purpose of manufacturing electrical goods. The incorporators are: Frank L. Wyman, of Indianapolis, Ind.; Scott H. Penfield, of Jamestown, N. Y., and Benjamin S. Dean, 609 East Eighth Street, Jamestown, N. Y.

THE KUHLMAN ELECTRIC COMPANY, of Elkhart, Ind., has been organized with a capital stock of $20,000 for the purpose of manufacturing and dealing in electric appliances, devices and supplies. E. Kuhlman is president of the company and John A. Johnson secretary.

THE M. & E. MANUFACTURING COMPANY, of Newton, Ia., has been granted a charter with a capital stock of $12,000 for the purpose of manufacturing lighting plants, fixtures and tools. The incorporators are: A. Elliott, R. S. Redman, F. G. Morrison, Lee Brown and C. H. Jasper.

THE MODERN SPECIALTIES MANUFACTURING COMPANY, of Goshen, Ind., has filed articles of incorporation, with a capital stock of $25,000, to manufacture and deal in all kinds of machinery, appliances, mechanical and electrical devices and specialties. The incorporators are: John Winter, Elmer E. Ash, Clinton C. Teidman and Albert Snapp.

THE MOORE CONTINUOUS SAFETY RAIL COMPANY, of Galesburg, Ill., has been granted a charter with a capital stock of $20,000 to manufacture and deal in railroad supplies and machinery. The incorporators are: R. D. Moore, Luke W. Sanborn, R. R. Drake, W. E. Doyle and R. C. Rice.

THE NIAGARA SEARCHLIGHT COMPANY, of Niagara Falls, N. Y., has been incorporated with a capital stock of $25,000 by R. M. Eaton, R. H. Gettens and R. R. Gessford, of Niagara Falls, N. Y. The company proposes to manufacture electric lamps, fixtures, etc.

THE PEABODY ELECTRIC COMPANY, of Muskogee, Okla., has been organized with a capital stock of $15,000 to do general electrical construction work. A. D. Peabody is president and F. H. Weber, secretary.

THE PENNSYLVANIA STEEL RAILWAY TIE COMPANY, of Dover, Del., has been incorporated by F. R. Hansel, of Philadelphia, Pa.; George H. Martin and S. G. Seymour, of Camden, N. J. The company is capitalized at $10,000,000 and proposes to manufacture and distribute iron, steel and metal products.

THE RICE MECHANICAL ENGINEERING COMPANY, of Waxahachie, Tex., has been incorporated with a capital stock of $50,000 by E. W. Rice, G. W. Coleman and J. T. Spencer. The company proposes to do a general engineering business.

THE SANITARY SUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 to manufacture vacuum cleaners. The incorporators are: C. Leviton, A. Lamb and J. Lowenhaupt.

THE SUNSET COMPANY, of Newark, N. J., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing engines, dynamos, electrical appliances, etc. The incorporators are: C. D. Winters, I. B. Glueckfield and J. Beckingham.

THE UNION ELECTRICAL COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $1,000, to do electrical construction work and deal in electrical supplies. The incorporators are: H. F. Karwiese, F. C. Whitener, H. A. Sigmier and W. J. Busam.

THE WHYLAND-NELSON MOTOR CAR COMPANY, of Buffalo, N. Y., has filed articles of incorporation with a capital stock of $10,000. The company proposes to manufacture motors, engines, motor vehicles, etc. The incorporators are: Frank A. Shoemaker, 91 California Street; Frank W. Whyland, 91 Claremont Avenue, Buffalo, N. Y., and Joel W. Nelson, 217 Second Avenue, New York, N. Y.

New Incorporations.

FRESNO, CAL.—The Kerman Telephone Company has been incorporated with a capital stock of $35,000, by T. F. Saunders, Jacob Mausar, H. A. Hechtman, W. I. Hechtman and J. A. Johnson.

WALLACE, IND.—The Wallace Co-operative Telephone Company has been incorporated with a capital stock of $13,000 to construct and operate telephone systems throughout Park and Fountain Counties. The directors are: Thomas Keller, A. B. Grimes, Butler Meyers, John Wallett and W. E. Spragg.

AUGUSTA, MAINE.—The American Volsam Company has been incorporated to build and operate plants to generate and distribute electricity and also to quarry minerals, etc. The officers are: E. J. Pike, president; L. J. Coleman, treasurer, and C. L. Andrews, clerk.

WESTFIELD, MAINE.—The Westfield Light & Power Company has been granted a charter with a capital stock of $10,000 to supply electricity for lamps, heat and motors in Westfield, Maine. The officers of the company are: Lincoln R. Sinclair, president; Enoch B. Briggs, treasurer, and Thomas C. Bell, clerk, all of Westfield, Maine.

BOSTON, MASS.—The United States Light & Heating Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are: Norman J. MacGaffin, Malvina P. Healey and Clarence R. Yeaton.

DEERWOOD, MINN.—The Cuyuna Northern Railway Company has been incorporated by Cuyler Adams, F. S. Adams and C. C. Adams, all of Deerwood. The company is capitalized at $1,000,000 and proposes to construct and operate an electric railway from Sherwood through Crow Wing County to a point on the Mississippi River.

Personal.

MR. C. E. SEARCH has been appointed works manager of the Allis-Chalmers Company of Milwaukee, succeeding Mr. David Van Alstyne, who has resigned, to take effect on Nov. 15.

MR. EUGENE C. IVEY, secretary and treasurer of the Citizens' Light & Power Company, Lenori, N. C., was married Oct. 25 at Charlottesville, Va., to Miss Annie Carver Vasseur.

MR. I. C. COPLEY, president of the Western United Gas & Electric Company, of Aurora, Ill., was elected president of the American Gas Institute at the recent convention in St. Louis.

MISS ANNEBELL FRASER, librarian of the Commonwealth Edison Company, Chicago, has been appointed assistant editor of the "Question Box" of the National Electric Light Association.

PROF. W. M. ANDERSON, who graduated from the Rose Polytechnic Institute in the class of 1894, has taken charge of the electrical engineering department of the University of Louisville.

MR. H. L. JUDD has been elected chairman of the North Shore Electric Company (Chicago) Section of the National Electric Light Association. He is superintendent for the company at Oak Park, Ill.

MR. A. W. HARPER has resigned from the commercial department of the Penn Central Light & Power Company, Altoona, Pa., to accept a position as commercial agent of the Sandusky Gas & Electric Company.

MR. DAVID VAN ALSTYNE, vice-president of the Allis-Chalmers Company, of Milwaukee, and in charge of its manufacturing operations, will sever his connection with that company on Nov. 15, in order to engage in business in New York. Mr. Van Alstyne was formerly vice-president of the American Locomotive Works.

MR. ETIENNE DE FODOR, general director of the Budapest General Electric Company, was recently the object of ovations from various

societies and congratulations from a host of friends upon the attainment of his thirtieth anniversary as an electrical engineer. A banquet given in honor of the occasion was attended by some members of the government, the Mayor, leading men of the municipality and a large number of engineers. Mr. de Fodor was born in Pressburg on Nov. 8, 1856, and after having finished his studies, he joined, in 1881, the few Edison pioneers that brought the incandescent system of lighting in Europe to a success. He has since been exceptionally successful as an engineer and a business man, and in Hungary is regarded as an authority upon all wide-reaching engineering subjects and projects.

MR. A. T. MACDONALD, for the past two years general traffic manager of the Louisville Lighting Company, of Louisville, Ky., has been appointed general sales manager of the company. The new position for Mr. Macdonald is an expansion of that which he has held previously. He will have charge of the soliciting force of the company and of the sale of energy in all directions. He will also continue to edit the company's paper, *Chained Lightning,* which has been a valuable sales developer. Mr. Macdonald was identified with the editorial departments of many leading newspapers until about four years ago, when, after service as president of the Greater Louisville Exposition, he was elected secretary of the Louisville Commercial Club. While holding this position he organized and presented the Southern Electrical Exposition at the First Regiment Armory, in Louisville, a display which called attention in an effective manner to the development of electricity in the South. Central stations and manufacturers co-operated to make this exposition one of the most successful of the kind ever held south of the Ohio River. Mr. Macdonald has received credit for much of the success of the Louisville Lighting Company in the direction of developing new business in store lightning, signs, electric vehicles and motor service.

Obituary.

MR. STEPHEN V. COOK died at his home in Chicago on Oct. 21, aged eighty-six years. Mr. Cook had a mechanical turn of mind and was interested in the telephone in its early development. One of his sons, Mr. Frank B. Cook, is well known as an inventor of telephone protective and other electrical devices.

MR. I. T. DYER, for a number of years superintendent of telegraph for the Chicago, Burlington & Quincy Railroad at St. Joseph, Mo., but more recently superintendent of telegraph for the San Pedro, Los Angeles & Salt Lake Railroad, with headquarters at Los Angeles, died at his home in the latter city on Oct. 25. Mr. Dyer was well known among railroad men.

Trade Publications.

STORAGE BATTERY CARS is the title of Bulletin No. 13, just issued by the Gould Storage Battery Company, 341 Fifth Avenue, New York. It explains the economics of the storage battery car, describes the standard type made by the Gould Company and cites the conditions under which storage battery cars can be used most profitably.

INERTIA VALVE GEAR.—Bulletin No. 36 of the Bates Machine Company, Joliet, Ill., describes and illustrates the new Bates inertia valve gear, now regularly applied to all Bates Corliss engines. This new gear has attracted much attention because of its positiveness and quiet operation, and the absence of hooks, springs and rollers.

SYNCHRONOUS CONDENSERS.—Bulletin No. 4859, recently issued by the General Electric Company, describes its line of synchronous condensers especially adapted for floating on the line for improving the power-factor. These condensers have been designed to meet the demand for a comparatively inexpensive high-speed machine of this nature.

SMALL PLANT DIRECT-CURRENT SWITCHBOARDS.—Bulletin No. 4876, issued by the General Electric Company, on the above subject, illustrates and describes that company's 76-in. direct-current panels designed for general use in small central stations and isolated plants and includes connection and dimension diagrams. A choice of protective equipment is given to meet different requirements in regard to price.

AMP-HOUR METERS.—Central-station managers selling energy for vehicle charging will be interested in Bulletin No. 19 issued by the Sangamo Electric Company, Springfield, Ill., describing amp-hour meters for use in this class of service. Complete wiring diagrams for various types of well-known electric vehicles given should prove of assistance to managers who desire to equip to meet the conditions of vehicle-charging service.

ROTARY CONVERTERS FOR RAILWAY SERVICE.—Descriptive Leaflet No. 2378, covering rotary converters for railway service, has just been issued by the Westinghouse Electric & Manufacturing Company. This is a four-page leaflet, 9½ in. by 11 in., and contains a number of illustrations describing the various parts of rotary converters, such as armature coils, spider, equalizer connections, collector rings, commutator brush riggings, etc. Under each illustration is given a short description of the method of construction of the part shown. One page is devoted to illustrations of rotary converters completely assembled.

BUSINESS NOTES.

DAY & ZIMMERMAN.—Mr. Kern Dodge having retired from the firm of Dodge, Day & Zimmerman, the business will hereafter be conducted under the name of Day & Zimmerman.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, of Lafayette, Ind., has opened a Chicago office at 404 Fisher Building for the sale of its meters and transformers. Mr. A. G. Lucas is the Chicago manager in charge of the new office.

CENTURY ELECTRIC COMPANY ESTABLISHES SEATTLE OFFICE.—The Century Electric Company, St. Louis, has established a district sales office at Seattle, Wash., which will be in charge, as district sales agent, of Mr. Henry T. Thedinga, 343 Central Building.

A. EUGENE MICHEL and staff, advertising engineers, have moved into the Park Row Building, 21 Park Row, New York, where larger space has been secured. Temporarily the photo-retouching and illustrating department will remain in the Hudson Terminal Buildings, but all business will be managed from the new offices.

PRINTOMETER.—The Minerallac Electric Company has transferred the manufacture of the instrument formerly known as the Chicago Printing Attachment to the Chicago Electric Meter Company. The device will be known hereafter by the trade name "Printometer." The Minerallac Company will continue to act as distributor.

HUGHES ELECTRIC STOVES.—One of the principal attractions at the Colorado Electric Show was the booth of the Colorado Electric Specialties Company, which was fitted up as an electrical kitchen and contained the complete line of Hughes cookstoves, ranges and plates. An electrically roasted lamb each day was served to visitors.

$75,000 FIRE AT BROOKLYN (N. Y.) SWITCHBOARD FACTORY.—The three-story brick factory of the H. Krantz Manufacturing Company, maker of high-grade switchboards and controlling apparatus, at Brooklyn, N. Y., was destroyed by fire on the morning of Oct. 29. The damage to building and stock was about $75,000, fully covered by insurance.

ROTH BROTHERS & COMPANY, Chicago, Ill., have recently shipped to the Wagner Manufacturing Company of Sidney, Ohio, manufacturers of aluminum ware, ten 5-hp polishing motors of a new, improved, ventilated type which the company has recently placed on the market. All ten machines will be used for polishing the aluminum utensils manufactured by the Wagner Company.

THE GRANGER ELECTRIC & MANUFACTURING COMPANY, of Warren, Ind., which manufactures a full line of heating appliances, including electric flatirons, toasters, heating pads, etc., has appointed Mr. Arthur P. Pierson, of 136 Liberty Street, New York, as its selling agent for New York and New England territory. A representative line of stock and samples will be carried in New York.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has received a number of inquiries since the fire at its Brookline works asking what effect the fire would have on the delivery of motors. The officers of the company desire that it may be clearly understood that the fire has had no effect whatsoever on the motor department, since that part of the company's work is conducted in a separate factory located in Boston. The Brookline factory is again in partial operation, and the delay in delivering sundries manufactured there will be but slight, the officials say.

THE NORTHERN EQUIPMENT COMPANY, Chicago, Ill., announces that it has completed a sales arrangement for its "Copes" boiler-feed regulators and "Copes" pump governors with the Dravo-Doyle Company, merchant engineer of Pittsburgh, which has recently established a steam specialty department, with headquarters in Pittsburgh, covering the Pittsburgh, Cleveland, Philadelphia, Chicago and West Virginia territories. D. D. Pendleton, who has for the past five years represented the Northern Equipment Company in the Pittsburgh district, has completed arrangements with the Dravo-Doyle Company so that it will have all rights in that district, thus giving it complete jurisdiction over the territory mentioned above.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November, 1911.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Honorary secretary, Ralph W. Pope; acting secretary, F. L. Hutchinson. Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Thorpe, Little Rock, Ark.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 135 Adams St., Chicago.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting (Hotel La Salle, Chicago), November 6 to 10, 1911.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, N. T. Wilcox, Lowell, Mass.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

ELECTRIC CLUB, CHICAGO. Secretary, N. F. Obright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Annual meeting, Chicago, Nov. 2, 1911.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

IOWA ELECTRICAL ASSOCIATION. Secretary, A. W. Zahm, Mason City, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

LOUISIANA ELECTRICAL ASSOCIATION. Secretary, W. H. Bower Spangenberg, 627 Poydras St., New Orleans, La. Meets third Monday of each month.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Next annual convention at Seattle, Wash., second week in June, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MISSISSIPPI SECTION. Secretary, A. H. Jones, McComb City, Miss.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRIC CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Joseph B. Ware, Grand Rapids, Mich.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. I. E. Sanborn, Ohio State University, Columbus, Ohio.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

PITTSBURGH ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Bombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. B. Moore, 39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y.

VERMONT ELECTRICAL ASSOCIATION. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next annual meeting Jan. 23-25, 1912.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 24, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,006,494. ELECTRIC BATTERY; W. Morrison, Chicago, Ill. App. filed Aug. 11, 1902. Bromine gravity battery with a bed of granular carbon containing free bromine.

1,006,504. ALTERNATING-CURRENT SWITCH; A Simon, Milwaukee, Wis. App. filed Feb. 21, 1907. Coils in axial alignment produce magnetic fluxes of different phase.

1,006,522. CIRCUIT-BREAKER; C. C. Badeau, Bethlehem, Pa. App. filed Sept. 18, 1906. Rolling contact between the arm and handle.

1,006,536. WELDING MACHINE; G. E. Dean, Albion, Mich. App. filed April 21, 1911. For welding rods to frames to form shelves, racks, etc.

1,006,537. WELDING MACHINE; G. E. Dean, Albion, Mich. App. filed July 13, 1911. For welding wire mesh to frames for shelves, etc.

1,006,560. RHEOSTAT FOR ELECTRIC MOTORS; J. T. Kalweit and W. H. Gaulke, Milwaukee, Wis. App. filed July 7, 1910. Box for starting switch and details of contacts, and mountings for the contacts and armature.

1,006,569. DEVICE FOR DRIVING ELECTRIC SECONDARY CLOCKS; G. O. Larsson, Stockholm, Sweden. App. filed Oct. 26, 1908. Has a condenser in the secondary clock circuit and contacts for charging and discharging.

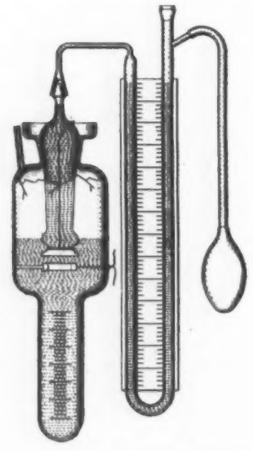
1,006,591. DEVICE FOR HOLDING RECEIVERS OF TELEPHONES; E. L. Persons, Concord, N. H. App. filed June 12, 1911. The receiver is carried by a long arm adapted to be moved by pressure of the head.

1,006,612. ELECTROLYTIC METER; E. Weintraub, Lynn, Mass. App. filed Feb. 14, 1910. Mercury is forced from a reservoir into the container by air pressure. Pressure is relieved by a capillary tube.

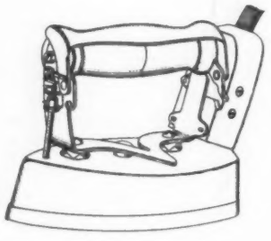
1,006,615. CENTRAL-ENERGY TELEPHONE SYSTEM; C. S. Winston, Chicago, Ill. App. filed March 10, 1906. Three-wire system for central-station wiring.

1,006,619. PROTECTION OF HIGH-TENSION DIRECT-CURRENT MOTORS IN SERIES; T. von Zweigbergk, Southport, England. App. filed March 28, 1910. A supplementary circuit from the motor side of a circuit-breaker has a terminal near the motor commutator so as to insure connection to the circuit-breaker in case of a flash.

1,006,620. TUNGSTEN FURNACE; A. Appelberg, Schenectady, N. Y. App. filed Oct. 16, 1908. Air-tight chamber is supplied with inert gas and has a door at the bottom.



1,006,612.—Electrolytic Meter.



1,006,727.—Automatic Flatiron.

1,006,631. SYSTEM OF ELECTRICAL DISTRIBUTION; W. H. Clarke, Chicago, Ill. App. filed July 1, 1907. For lamps or other translating devices in multiple on a variable potential.

1,006,635. SPACE TELEPHONY; L. De Forest, New York, N. Y. App. filed July 8, 1907. A telephone transmitter and electromagnets are arranged near the spark electrodes in the antenna.

1,006,636. SPACE TELEPHONY; L. De Forest, New York, N. Y. App. filed July 8, 1907. A plurality of transmitting devices and a plurality of independent oscillation circuits.

1,006,651. ELECTRIC-LIGHT-SOCKET CAP; J. H. Goss. Waterbury, Conn. App. filed Jan. 3, 1911. Connection between the cap and its hub.

1,006,655. ELECTRIC RESISTANCE; R. C. Harris, Gateshead, England. App. filed Feb. 18, 1911. A strip is perforated and bent so as to bring the perforations into alignment for a supporting rod.

1,006,657. VAPOR ELECTRIC DEVICE; J. L. R. Hayden, Schenectady, N. Y. App. filed April 16, 1907. The evacuated envelope has a condensing chamber for gases formed by the operation.

1,006,673. COMMUTATOR OF DYNAMO-ELECTRIC MACHINES; C. A. Parsons, A. H. Law and J. P. Stockbridge, Newcastle-Upon-Tyne, England. App. filed April 9, 1910. The commutator bars and connectors are dovetailed and inter-connected.

1,006,697. ACID-PROOF ELECTRIC-BATTERY TERMINAL; K. R. Smith, Totnes, England. App. filed Feb. 15, 1907. The wire is connected to the electrode by a celluloid plug and sleeve.

1,006,703. RELAY; A. L. Townsend, Washington, D. C. App. filed March 23, 1911. Self-polarizing and self-adjusting for telegraphy.

1,006,727. AUTOMATIC FLATIRON; A. S. Cubitt, Pittsfield, Mass. App. filed May 7, 1910. Has a switch controlled by the grasp of the hand and also thermostatically.

1,006,729. ATTACHMENT FOR VAPOR LAMPS; A. Dempster, Schenectady, N. Y. App. filed Nov. 9, 1905. Automatic electromagnetic cut-in.

1,006,744. DYNAMO-ELECTRIC MACHINE; V. A. Fynn, London, England. App. filed May 26, 1910. Self-exciting and self-regulating.

1,006,749. CONTROL MECHANISM; H. Haudenschild, Toledo, Ohio. App. filed Jan. 20, 1908. Compact rheostat-controlling switch and brake as for sewing-machine drive.

1,006,756. ELECTRIC BRANDING DEVICE; J. A. Jordan, Bangor, Ireland. App. filed Feb. 25, 1911. Hand device for branding meat.

1,006,767. ELECTRIC HAIR-DRYER; H. J. Mauger, Schenectady, N. Y. App. filed Jan. 19, 1910. A lamp, motor, fan and reflector.

1,006,774. BINOXIDE-OF-HYDROGEN ELECTRODE; W. Morrison, Des Moines, Ia. App. filed Nov. 29, 1909. Binoxide is added to a solution of sulphate of ammonia for treating the paste.

1,006,786. SPACE TELEGRAPHY; G. S. Piggott, Chicago, Ill. App. filed June 19, 1903. Signaling means control the discharge between the sparking terminals of a static electric machine.

1,006,795. SPARK-GAP; J. D. Robertson, Toledo, Ohio. App. filed Nov. 30, 1910. A non-conducting plug with a spark-gap inside and a sight opening; for testing ignition circuits.

1,006,802. AUTOMATIC CIRCUIT-CONTROLLER FOR ELECTRIC MOTORS; S. Sparrow, St. Louis, Mo. App. filed May 27, 1909. Centrifugal governing device for short-circuiting the individual coils of the armature.

1,006,805. MERCURY-VAPOR DEVICE; E. Thomson, Swampscott, Mass. App. filed Jan. 21, 1911. The envelope with electrodes is inside a closed receptacle containing gas under pressure.

1,006,824. ALARM-ACTUATING MECHANISM FOR INCUBATORS; W. M. Braly, Blackwell, Okla. App. filed April 2, 1910. A thermostat and electric alarm.

1,006,833. TELEPHONE RECEIVER; W. W. Dean, Elyria, Ohio. App. filed Oct. 8, 1908. Sheet-metal shell.

1,006,835. MAGNETIC SEPARATOR FOR ORES; J. B. Etherington, Winthrop, Mass. App. filed Jan. 24, 1910. The table is supported upon horizontal bars arranged to vibrate in guides transverse to the line of ore feed.

1,006,836. PROCESS AND APPARATUS FOR ELECTROLYTIC RECOVERY OF WASTE LIQUOR; F. F. Farnham, McKeesport, Pa. App. filed Aug. 11, 1911. Iron and sulphuric acid from ferrous sulphate.

1,006,864. ELECTROTHERAPEUTIC APPARATUS; M. G. McElhinney, Ottawa, Can. App. filed March 15, 1910. A condenser receiving static charges is periodically neutralized to produce a pulsating current.

1,006,876. METALLURGY OF ZINC ORES AND COMPOUNDS; A. L. J. Queneau, Overbrook, Pa. App. filed Jan. 7, 1910. Electrically heated rotating furnace with a fluid resistor.

1,006,877. METALLURGY OF ZINC; A. J. L. Queneau, Philadelphia, Pa. App. filed June 8, 1911. Rotary reducing chamber with a molten resistor and a condenser.

1,006,884. ELECTRIC LAMP SOCKET; F. E. Seeley, Bridgeport, Conn. App. filed April 4, 1910. Thumb turn snap switch with sliding contacts and quadruple break.

1,006,898. WATER-LEVEL ALARM FOR BOILERS; L. Beebee, Saginaw, Mich. App. filed April 15, 1910. Steam whistle and electric signal controlled by a float.

1,006,901. RAILWAY SIGNAL; A. H. Bernadou, Philadelphia, Pa. App. filed May 26, 1908. Bell signals to alarm the entire tram crew in case the train approaches an occupied block.

1,006,981. LOCK SWITCH; T. D. Robinson, Lockport, N. Y. App. filed Jan. 24, 1911. Combination lock for automobile ignition circuit switches.

1,006,996. CIRCUIT-CLOSER FOR TROLLEY SIGNALS; W. M. Chapman, Needham, Mass. App. filed May 28, 1908. A circuit-closing arm is arranged near the trolley wire and a retarder holds the signal circuit closed a short time after passage of the trolley wheel.

1,007,000. HEATING SYSTEM; E. E. Gold, New York, N. Y. App. filed Dec. 23, 1910. A hot-water system with an electric heater inserted inside a portion of the pipe.

1,007,003. ARC LAMP; J. W. Kendrick, Franklin, Pa. App. filed Feb. 17, 1910. Rotatable disk electrodes for projectors, moving pictures, etc.

1,007,005. METAL JOINT; A. Lukasewske, New York, N. Y. App. filed May 27, 1905. "Thermit" joint as between a copper bond and a steel rail.

1,007,030. TELEPHONE TRANSMITTER; A. A. Jahnke, Richmond, Cal. App. filed Nov. 18, 1910. Two fluids of different conductivity meet back of a diaphragm whose vibrations vary the cross-sectional area of the fluid column.

1,007,031. MICROPHONE TRANSMITTER; A. A. Jahnke, Richmond, Cal. App. filed Nov. 18, 1910. The carbon is kept cool by alcohol vapor.

1,007,036. TELEPHONE SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed May 28, 1909. Trunking system.